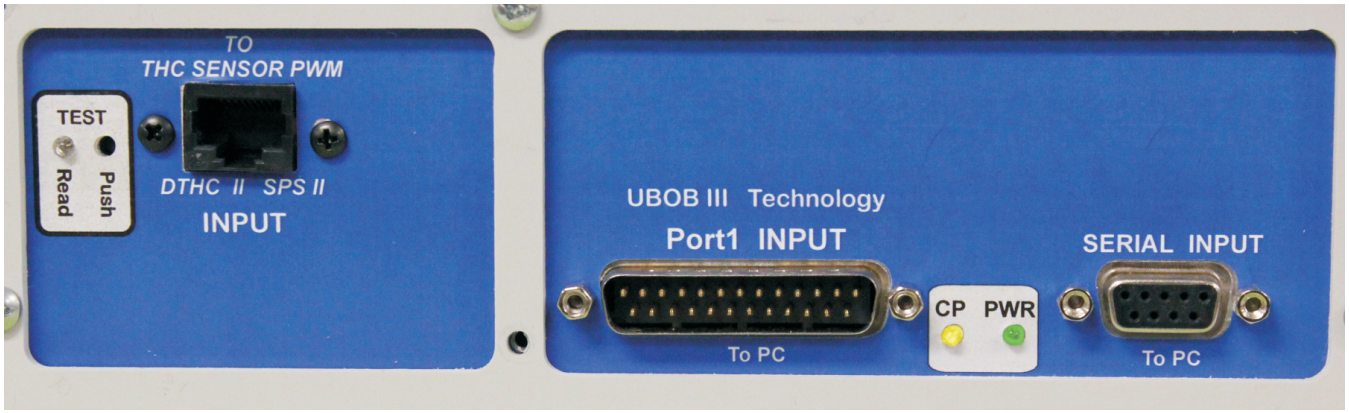
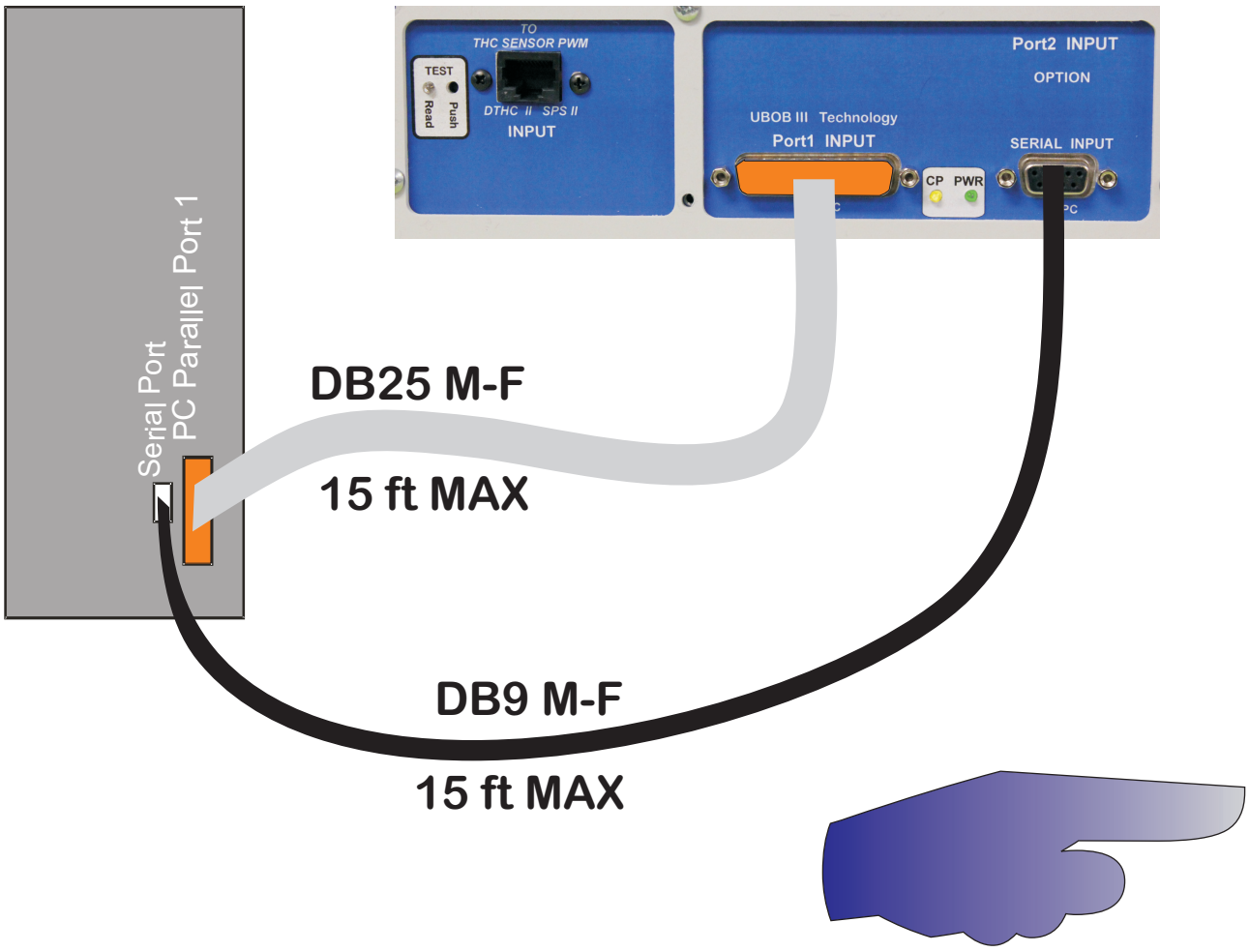
BLADERUNNER AIO RIGHT SIDE VIEW
INPUTS FOR UBOB III AND EXPANSION OPTIONS



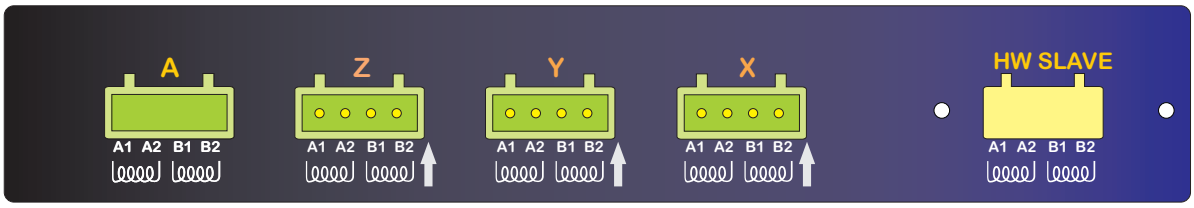
CLOSE UP VIEW UBOB MODULE
RIGHT SIDE

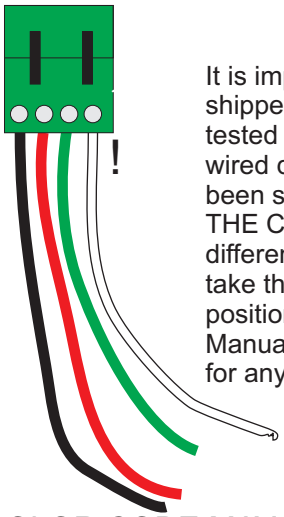
Connecting up the BladeRunner Control box. Take a look at the block diagram, that gives an overview of the control box. Note that there are two cables that run from the **PC** and connect to the BladeRunner box. These are labeled Port 1, and Serial It's important that you connect the first parallel port in the computer (normally the existing printer port or LPT1 port) to Port 1 on the BladeRunner Controller box There are also other cables that connect three satellite cards (Table I/O, and THC Sensor Module/VFD Interface Card) to the BladeRunner-DTHCII or Spindle Speed as well. The Table I/O is connected Internally and is not part of the connections to the PC.

1. Install a DB25 **Male to Female** extension cable (All pins straight through) between parallel port (PORT1 on the PC to the part marked Port 1 INPUT (Orange highlight below) on the front of the MP3000-DTHC controller unit.
2. Install a straight through DB9 Male to Female cable (not a null modem cable) from your Com1 port on the PC to the Serial port on the BladeRunner



NOTE: For BladeRunner Servo system please see the end of the F section for the differences in the motor connections



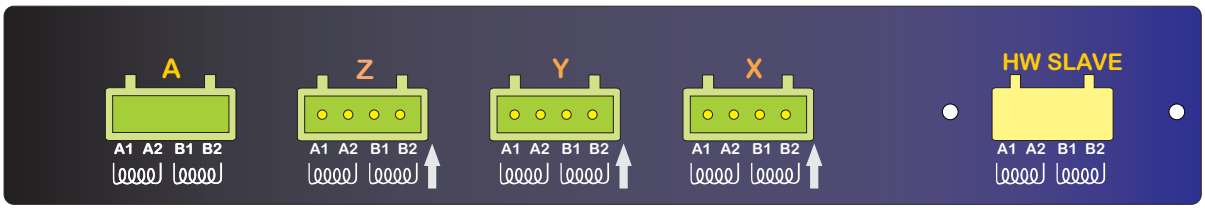


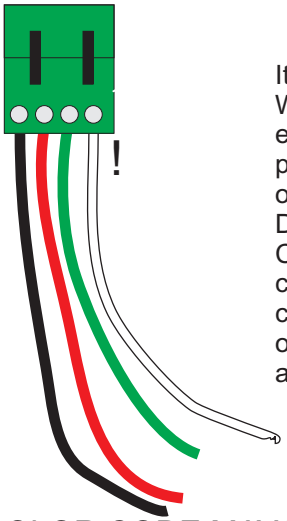
COLOR CODE MAY VARY

IMPORTANT:

It is important that the stepper motor wires are wired correctly. When shipped from the factory the motors are wired right and each one is tested with the unit. Because motors for other products we sell are wired differently it's possible a motor you order after the unit has been shipped could be wired differently. DO NOT ASSUME THAT THE COLOR OF THE WIRES IS CONSISTENT. We order wire from different sources and cannot always define the wire colors. If you take the connectors off for any reason either mark the wires by position or use an ohmmeter to test for coil pairs (see Bladerunner Manual PartII Service Manual). If you use any other motor or rewire for any reason CHECK TO MAKE SURE THE COILS ARE

BLADERUNNER G251-4 MODULE FRONT PANEL FUNCTIONS





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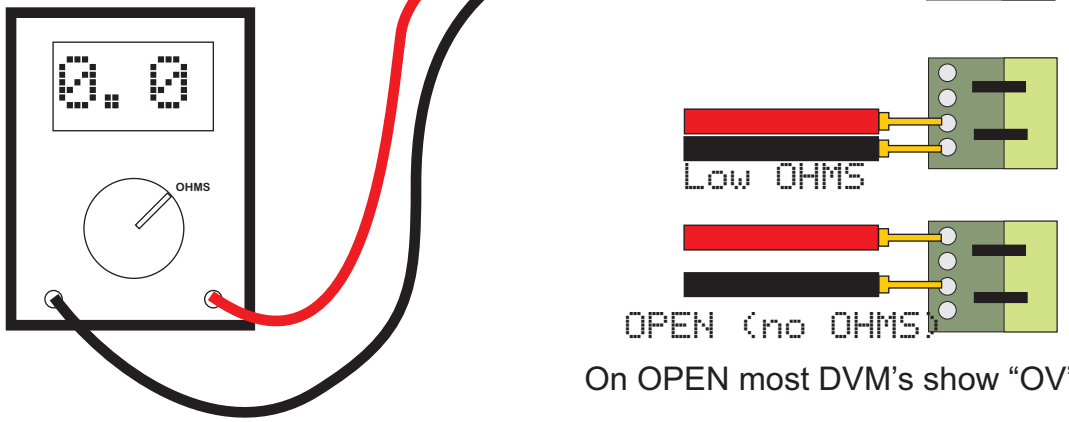
TESTING FOR PROPER MOTOR HOOKUP

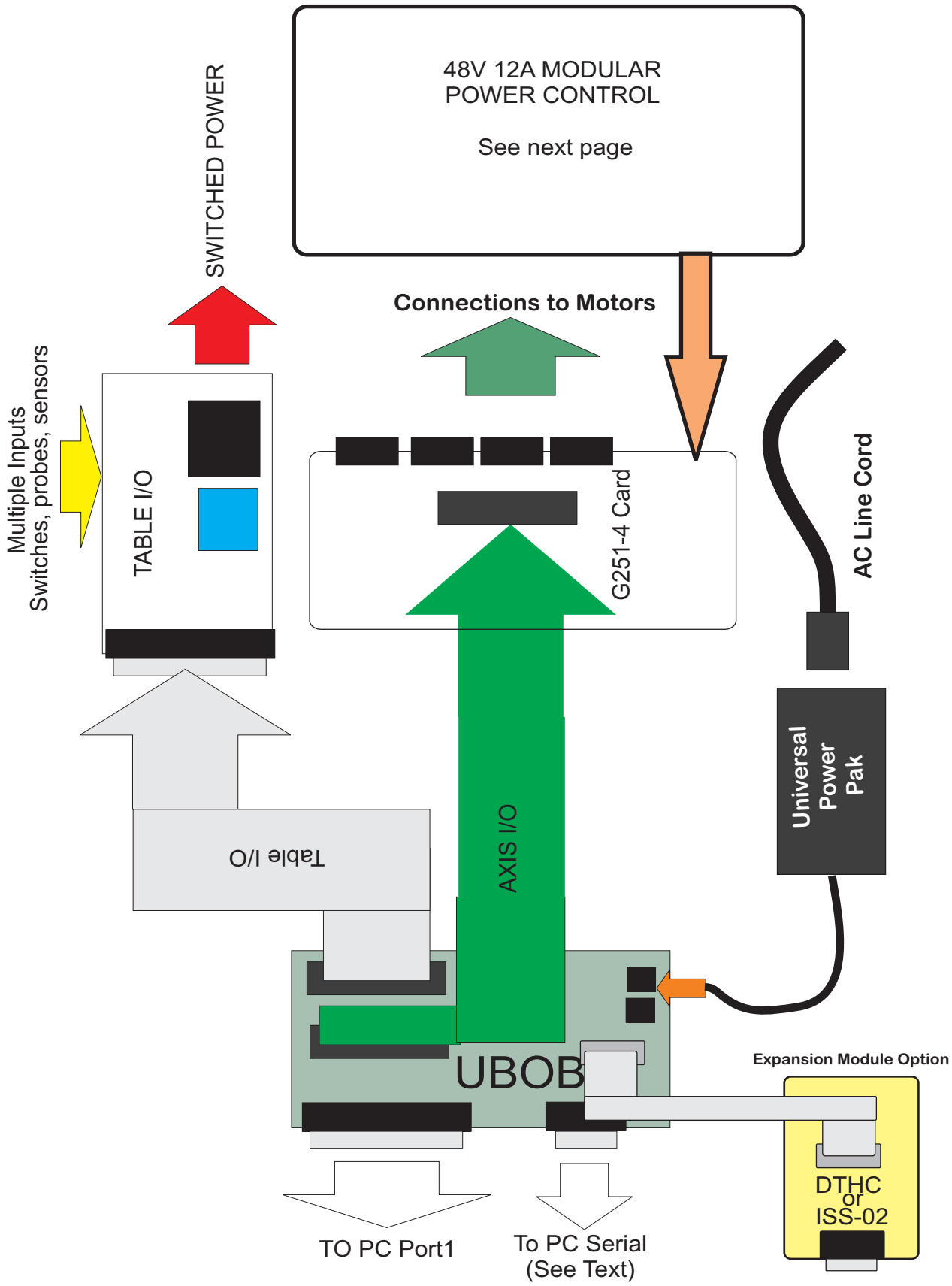
Motor DC resistance per coil is less than 50 ohms



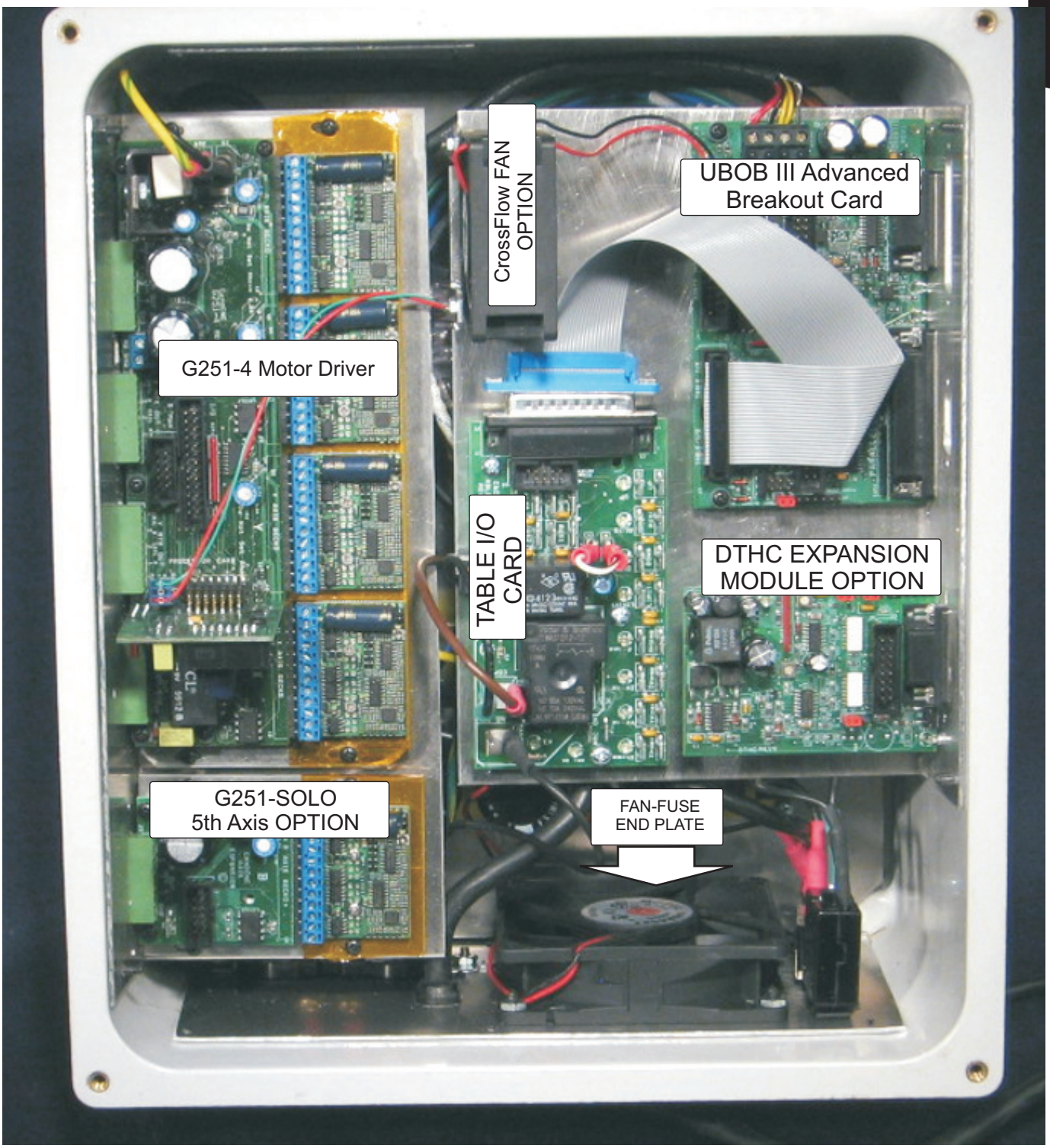
On OPEN most DVM's show "OV"

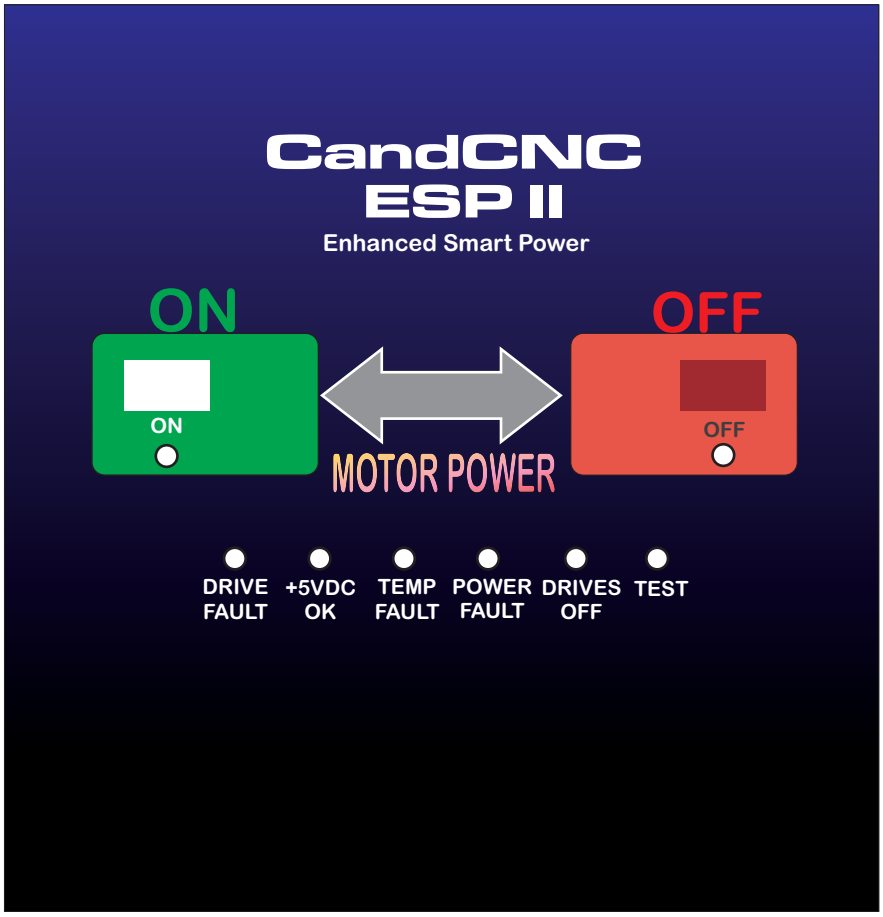
Put meter on lowest OHMS scale

BASIC BLADERUNNER AIO BLOCK DIAGRAM



BladeRunner AIO Cover Removed Inside View



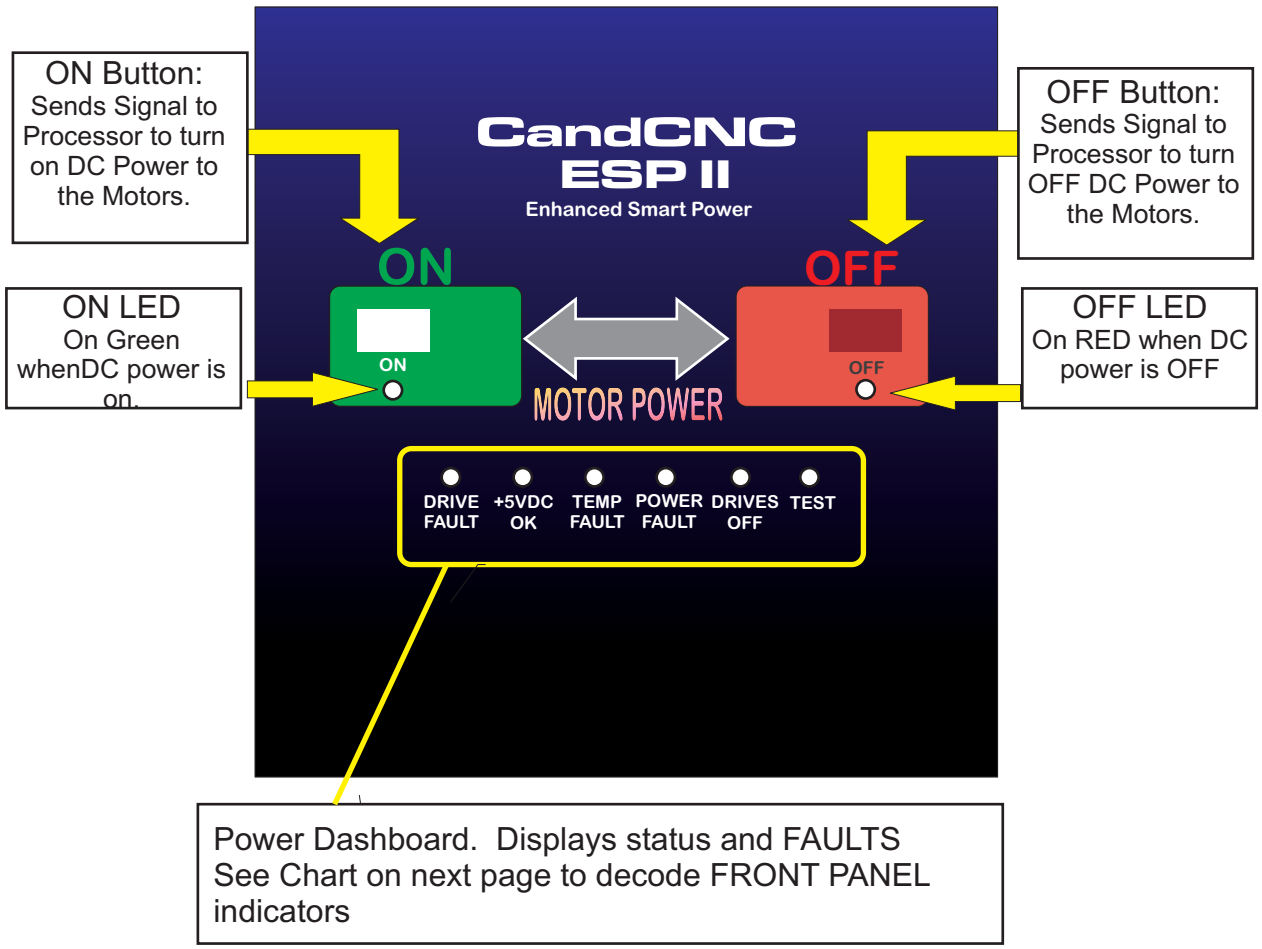


BLADERUNNER AIO FRONT PANEL
[Enhanced System Power II]

Located on the Front Cover of the ESPII Enclosure, the FRONT PANEL is the Operator Interface for the ESPII and provides tactile pushbuttons to turn the DC power to the Motors ON/OFF. The FRONT PANEL is a SMART CONTROL utilizing a powerful microprocessor that monitors and controls the power section of the BladeRunner AIO. The ESPII monitors critical parameters, controls ON/OFF, and will automatically shutdown in microseconds in the event of a fault. The ESPII monitors/controls:

1. System DC status
2. System Driver Status (enable/disable drives)
3. DC voltage level (overvoltage shutdown)
4. DC current (load) level (overload shutdown)
5. Internal Temperature (overtemp shutdown)
6. System Fault Indicators (LED's and Screen Text)

Normal Power up sequence:
1. Operator turns on MAIN POWER SWITCH. +5VDC LED comes on; RED OFF LED comes on; DRIVES OFF LED comes on. All LEDS may sequence on once during processor turn on.
2. Operator pushes ON Button. ON LED turns Green OFF LED goes off. Power comes up on DC bus. Approx 2 sec later Drives OFF LED goes off and MOTORS LOCK



IMPORTANT INFORMATION: The ESPII provides multiple levels of protection for the system and the motor drivers. Electronic fusing will shutdown power in milliseconds as opposed to conventional fuses. The Primary AC has two levels of control. The MAIN POWER SWITCH and the in-line SAFETY RELAY (controlled by the FRONT PANEL. The Safety RELAY controls AC power to the DC power supply section. Besides Electronic fusing the system also provides failsafe conventional fuses/breakers. There are two levels of conventional fusing on the DC power side. The locations and values of the conventional fuses are in the ESPII service Manual.

FRONT PANEL LED LEGEND

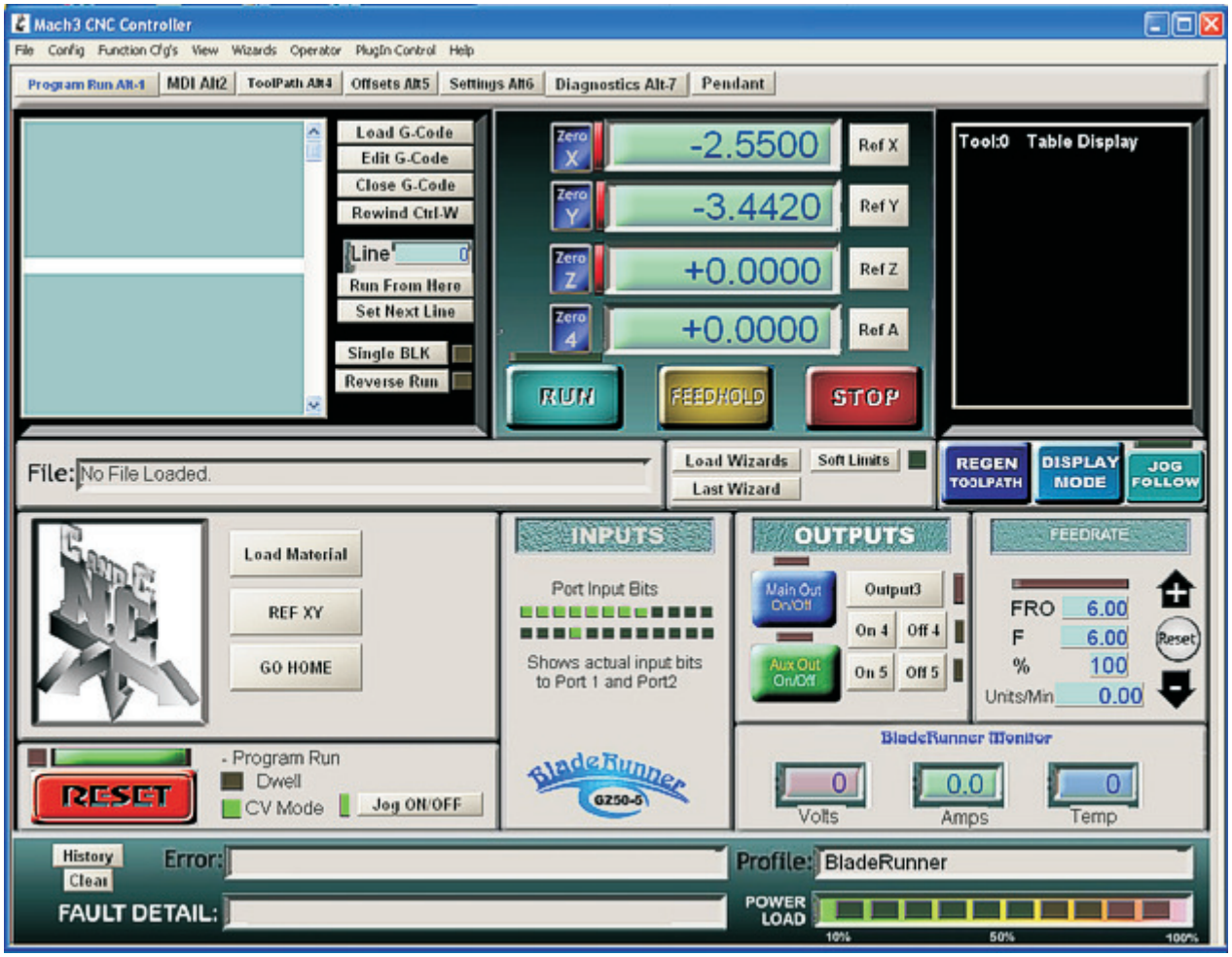
Note: LED!s flash several times on intial power up. Pushing recessed TEST button will test all LED!s and show common patterns for comparison

INDICATOR	Color	STATE	MEANING	NOTES
DRIVE FAULT	RED	1 flash /pause	X Drive Fault	A Drive Fault indicates a shorted motor/cable or a failed Motor Driver.
DRIVE	RED	2 flash /pause	Y Drive Fault	
DRIVE	RED	3 flash /pause	Z Drive Fault	
DRIVE	RED	4 flash /pause	A Drive Fault	
DRIVE	RED	5 flash /pause	5th Drive Fault	May indicate misconfigured Slave Axis Setup
+5 VDC OK	GRN	ON Steady	+5 is ON/OK	Shows power on and logic supply OK
TEMP FAULT	RED	1 flash /pause	Case Temp Fault	Internal Case Temp is too high. Check fans and filters
POWER FAULT	RED	Fast Flash	Power Overload **DC POWER**	Too Much Current drawn Auto Shutdown. Overload of power Module(s)
POWER FAULT	RED	Slow Flash	Over Voltage	DC Volts Exceed max for safe operation. Line surge or back EMF. Auto Shutdown
DRIVES OFF	YEL	ON Steady	Drives Disabled	Only on BladeRunner. Shows drives are freewheeling (disabled). Normal condition during.power up and faults/shutdown
TEST	YEL	ON Steady	Test Mode	Unit is in self test
TEST	YEL	Flashing	Config Error	MODE Configuration error or unplugged module.

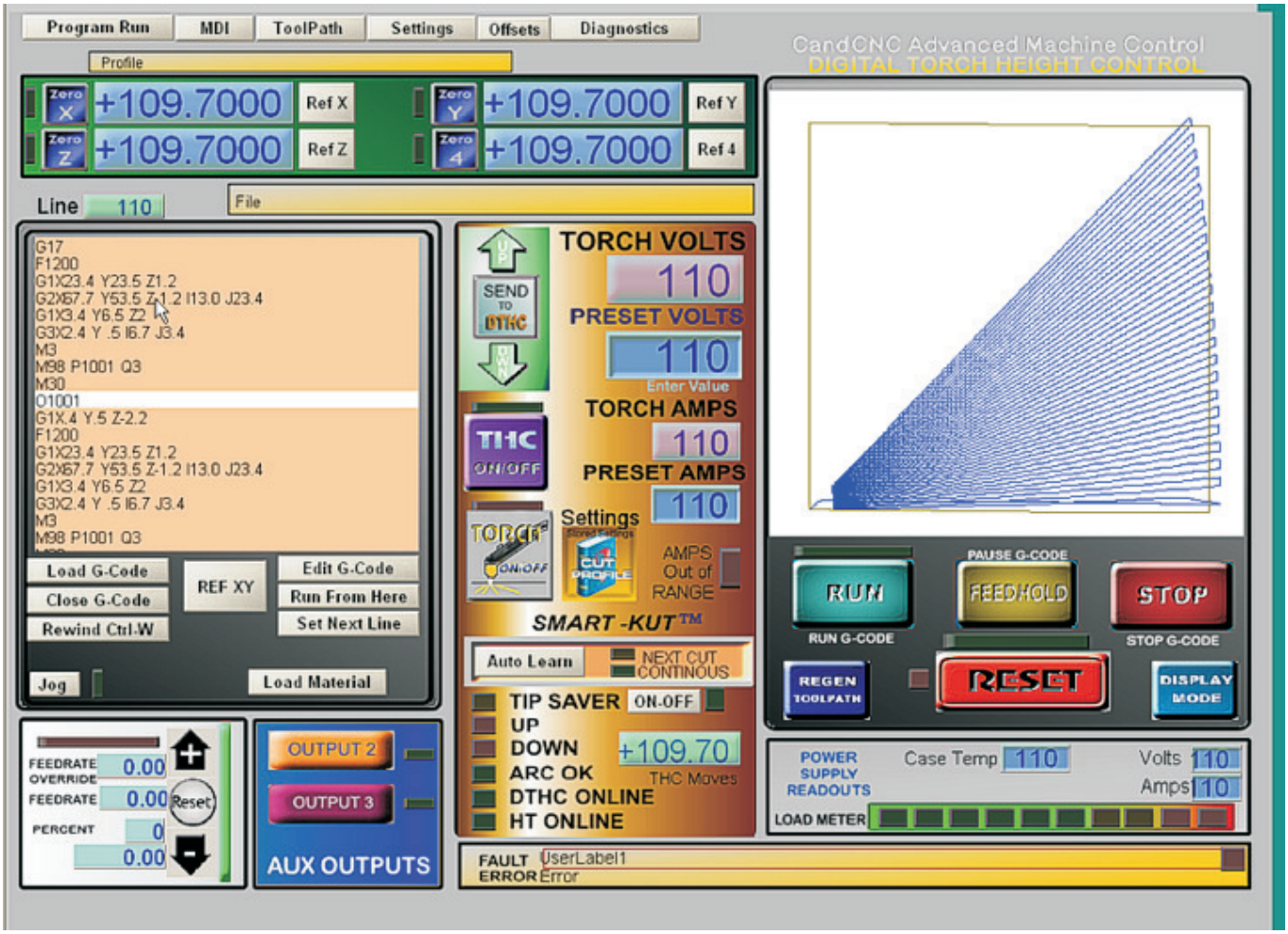
Load and Testing MACH

After you have installed MACH and run the BladeRunner INSTALL on the Support CD, open MACH3 using either the MACH Loader and the BladeRunner selection from the list OR using the BladeRunner Icon created in the desktop.

You should see the following screen or something very close. If you are missing the Desktop icon or it's not in the selection list, re-run, the INSTALL again. If you have the Profile (BladeRunner) listed in the MACH LOADER and the screen does not display, go to the top menu bar and select **VIEW/Load Screens** and navigate to the MACH3 folder and select BladeRunner-Router.set. If it is missing any of the Bitmaps (picture buttons and/or backgrounds) then confirm the Installer created the CandCNC folder under the MACH3/Bitmaps Folder and there are files in that folder. We have included a Zip file on the CD of all the bitmaps and the ZIP file is on the CandCNCSupport Forum site in the FILES/BladeRunner Support Files Folder. You can UNZIP the files in the Bitmaps.ZIP file directly to the MACH3/Bitmaps/CandCNC folder. Along with bitmaps and other features the BladeRunner screens contain several custom functions embedded as code behind certain buttons. If you elect to use another screen SET file with the BladeRunner be aware some functions will not work**. The DTHC screens have specific functions and the DTHC functions will not work on other screen sets.**



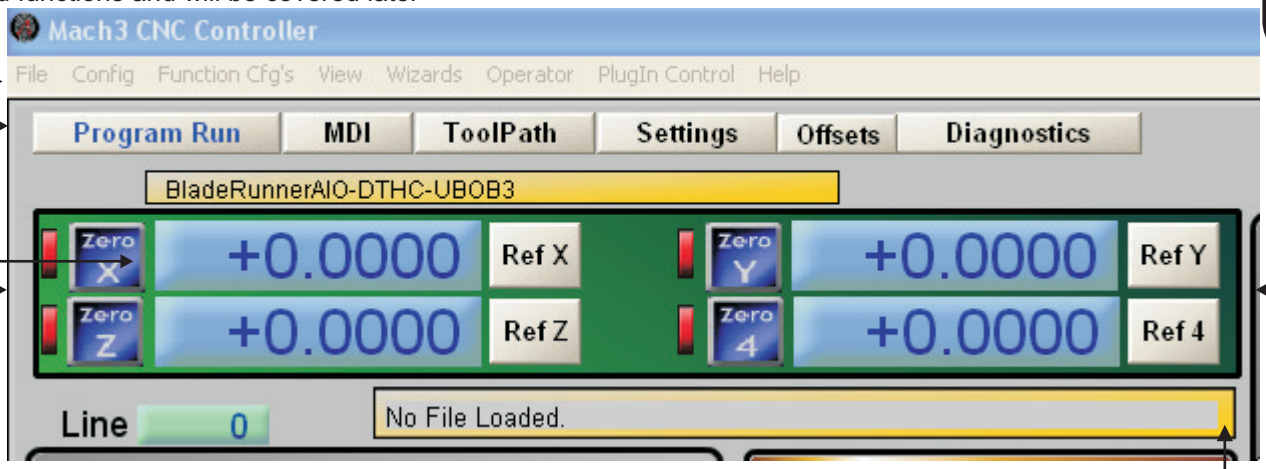
CUSTOM CandCNC Screen SET provided with BladeRunnerAIO UBOB3 install file. Some features may change over time. DTHCII specific functions are covered in detail in the DTHCII User Manual



BladerRunner DTHC
PLASMA PROFILE SCREEN

MACH3 TOP MENU. POPS up windows on top of the screen to access various settings. Three most used are: 1. Files 2. Config 3 View. This menu row is visible and can be accessed from all screens

MENU SCREEN SELECTION. Consists of tabs to select different screens. In normal run mode the PROGRAM RUN screen is the most used. The DIAGNOSTICS screen is used to confirm proper settings and functions and will be covered later



DRO (Digital Readouts) for axis position and for manual referencing and zeroing the DRO's REF buttons move an axis towards an associated HOME switch. When the axis hits the switch It will stop and backup slightly. If it moves the wrong way or does not move at all see the section on **CONFIG/HOMING & LIMITS**

Current G-Code File Loaded or running

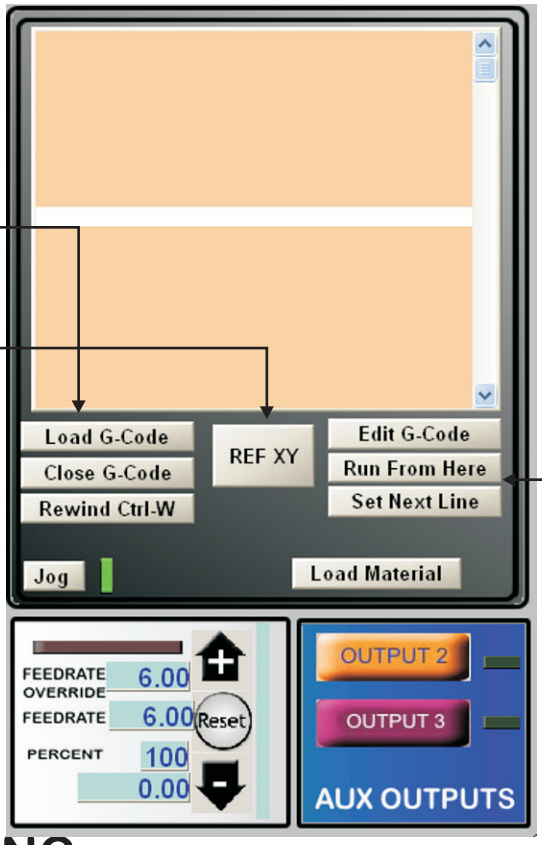
RUNNING PROFILE Box Shows the current MACH PROFILE you have running.

Function Buttons allow control of the G-code, Loading and Closing G-code and a rewind to the start button

REF XY Button, performs a REF move on XY at the same time but not on Z. Useful on plasma after the first REF has been done to locate 0.0

JOG ENABLE Button Turns keyboard jog on/off (should stay on normally)

FRO Feedrate Override changes feedrate on all Axis at the same time

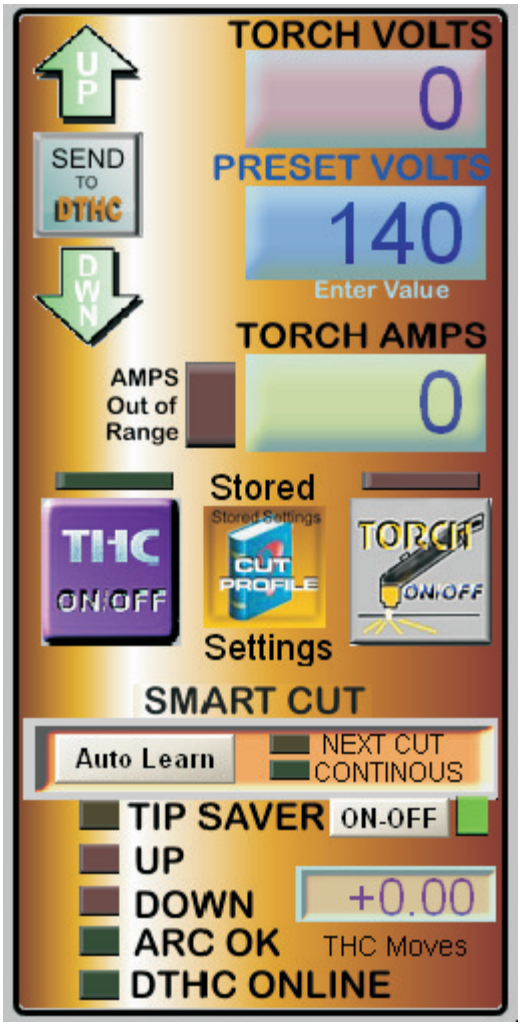


Loaded/Running G-code screen shows g-code as it is executed. Stopped code can be scrolled and new start points selected. The code can be Edited using the Edit G-Code Button

Function Buttons allow control of the G-code, Loading and Closing G-code and a rewind to the start button

LOAD MATERIAL button initiates a move to a preset postion

OUTPUTS ON/OFF Buttons Turns on/off the two AUX relays (table i/o Card). Bladerunner AIO has two wired AC sockets that are controlled from these buttons



INDICATOR LED's

TIP SAVER (turns on when TIP saver is active. TIP SAVER is a dynamic anti-dive that keeps the torch from diving on corners or when crossing a void or existing kerf

UP/DOWN/ARC OK shows the statues of those inputs from the DTHCII. These are the COMMANDS from the DTHCII to MACH.

DTHC ONLINE shows the communication status of the DTHCII module to MACH3. It MUST be on to allow MACH to display screen values and to allow Cut Profiles to transfer to the DTHCII

DTHCII SCREEN SECTION.

A detailed breakdown of all the buttons functions and readouts on the DTHCII section are covered in the DTHCII User Manual (separate manual) Only general descriptions are covered here.

UP/DWN and Send to DTHC Button. Any value typed into the PRESET VOLTS and ENTER is used to lock the value inthe DRO is instantly transferred to the DTHCII memory when the Send to DTHC button is hit. The User/operator can quickly change the PRESET VOLTS before or DURING a cut and change the ARC GAP in the process

TORCH AMPS Displays the action Cutting AMPS IF the CandCNC DCP01 Digital Current Probe has been installed. Otherwise it reads zero. IT IS NOT USED FOR THE CUT CURRENT PRESET value.

THC ON/OFF turns the THC function In MACH ON or off. The DTHCII can turn this on automatically when the torch fires (setting in the Cut Profile) Operator can turn the THC on/off manually. When THC is off MACH ignores any commands from the DTHCII to move the Z

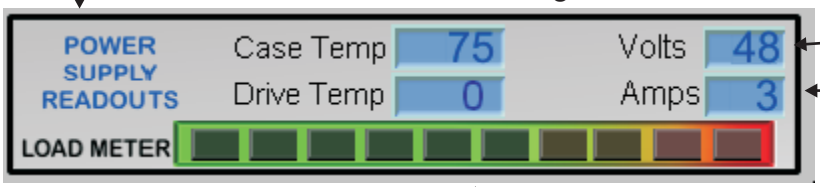
TORCH ON/OFF toggles the torch (OUTPUT1) on/off manually from the screen. The torch can be turned on or off at any time MACH is out of RESET....even during a run

STORED SETTINGS (CUT PROFILES). This button opens a window that displays a range of values and settings for the DTHC to use. The initial display is of the CURRENT SETTINGS in the DTHCII memory. Profiles by material can be recalled. selected and added. Detailed use of the CUT PROFILES is covered in the DTHCII User Manual

IMPORTANT: There are Self-Tests that can be preformed on the DTHCII modules and other modules in the setup. They establish that the modules are functional and sending data to both the parallel port inputs and the PC serial input. If you do not have proper display of values while cutting or the DTHC ONLINE is not ON you are missing critical signals. See the DTHCII User Manual to run the tests

POWER SUPPLY DASHBOARD. Displays realtime values of the ESPII Smart Power systems used in the BladeRunner controllers. All critical parameters are monitored and if a level reaches a point that is too high it will trip a fault and shutdown the power to the motors. Faults will display in the FAULT MESSAGE BOX (previous page)

CASE TEMP: Internal temperature of the BladeRunner enclosure In deg F.



VOLTS Power Supply DC Volts. Displays power supply voltage to motors (ESPII Smart Control... only on when DC power is on.

DRIVE TEMP- NOT USED

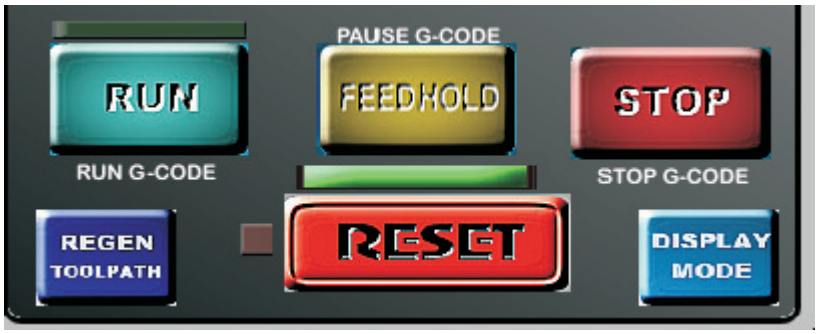
Dynamic Load Bar Graph

AMPS shows the total current drain of ALL motors that are attached. Current increases with the load on each motor

FEEDHOLD Pauses G-Code at end of buffer. Leaves outputs active

STOP Stops G-code execution instantly (dumps buffer) Turns off ouputs

RUN (Cycle Start) runs g-code that is loaded . Will restart g-code if in PAUSE or STOP



NOTE: To stop gracefully (no lost position) use the FEEDHOLD and after machine motion has ceased use the STOP.

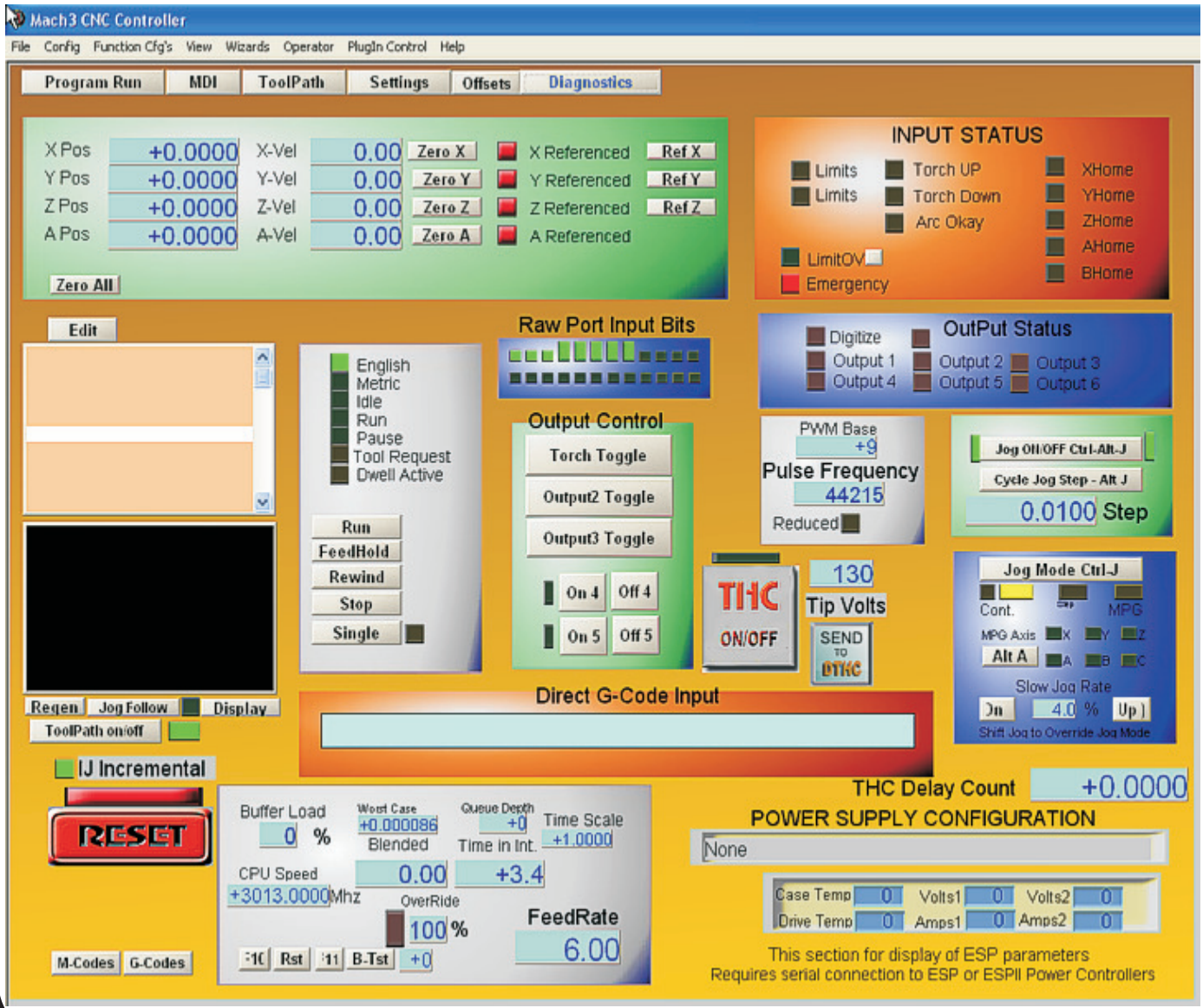
RESET (Toggle ON/OFF) Stops all code, Turns off all ouputs, Stops any macro. Turns off Charge Pump Toggle turns

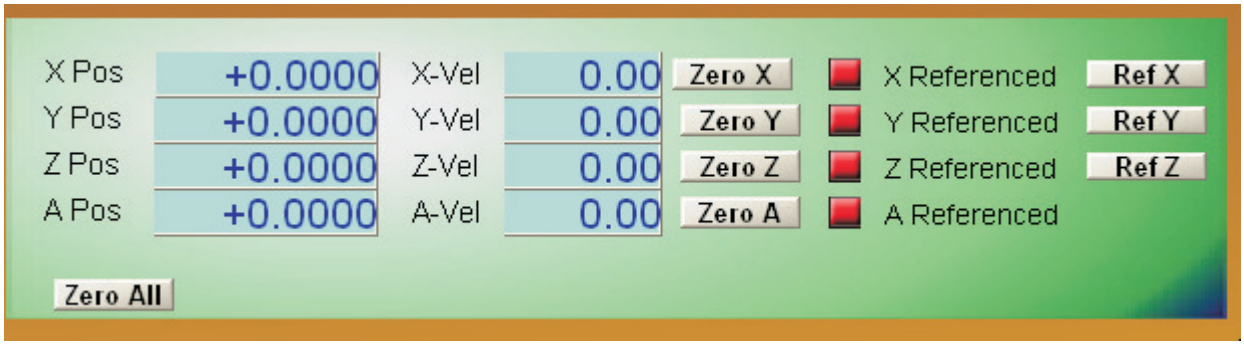
FAULT - ERROR Message box. Scrolls FAULT messages from CandCNC ESPII and other "smart" devices. Shows drive faults, Power Faults and Hypertherm Fault messages for units equipted with otions RS485 port and optional HyT-Connect RS485 SIM Kit.

ERROR messages are information and critical messages from the MACH system.

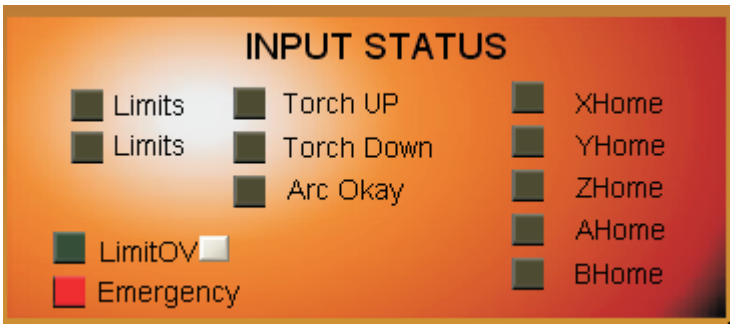
Diagnostics Tab

Used to test and diagnose general Input and output problems and to do test runs.

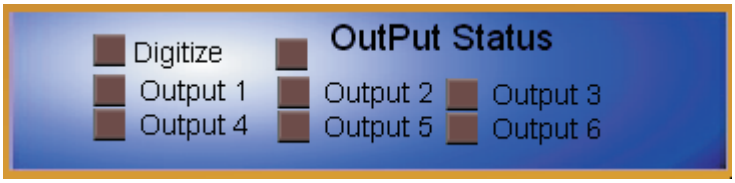




AXIS CONTROL Diagnostics: Has the same DRO's the same Axis ZERO buttons and manual REF buttons as the Program Run Screen so the User can see the numbers without have to flip back and forth. When troubleshooting you can see activity on an axis and do setup if needed.



INPUT STATUS BOX: Shows the Inputs as they are mapped in MACH. The Inputs are YELLOW when ON (active). The inputs should all be OFF (grey) when the system is first turned on and MACH is out of RESET. There MAY be an Emergency (E-STOP) on if the DC power to the motors is off on the BladeRunner. The Limits will seldom light because as soon as a LIMIT goes active, to puts MACH in RESET and the INPUTS are no longer displayed correctly. It turns the LIMITS OFF as soon as the LIMIT goes active. The indication a LIMIT is working is if when hit it puts MACH into RESET. The setup or HOMEs and LIMITS will be covered in later in this manual. Use the INPUT Status to test the individual inputs. Please note that Inputs FIRST hit specific pins on the parallel port and the MACH PROFILE determines what each one does so if you have inputs that are not correct the first thing to check is the RAW PAORT INPUT BITS on the following pages.



OUTPUT STATUS: Displays the status of the OUTPUTS/ Active outputs FLASH RED (not on steady) It uses the mappings in MACH to activate a specific out NAME. The physical output that is matched to is set in the PROFILE (Ports&Pins/Ouput Signals) When you activate an output like the TORCH Output or Outputs 1 and 2 you should see them start and flash in the OUTPUT STATUS BOX. It does not mean the actual output signal name is active only that the signal is active and if mapped properly should activate the specific output on the BladeRunner. See the section on setting the OUTPUTS

OUTPUT Status (Cont). There are two AUXILLARY OUTPUT Relays on a BladeRunner AIO unit. They are designed as Output 1 and Output 2 on the Buttons and they toggle ON/OFF the AC Outlets A and B on the end of the BladeRunner Box. These AC outlets are wired to the AUX AC line cord on the BladeRunner. That cord must be plugged in before the outlets can be used. CAUTION there is high voltage (120VAC) at the Relays and the Outlets. DO NOT OPERATE THE BLADERUNNER WITH THE AUX AC CORD PLUGGED IN AND THE TOP COVER REMOVED.

NOTE: The number of output relays can be expanded by adding in a Quad Relay Expansion card but is seldom used so connections and setup are not covered here

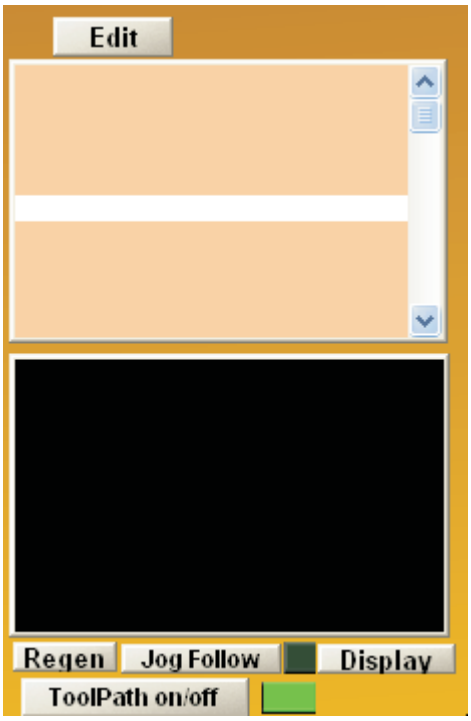
On a BladeRunner Dragon-Cut (with DTHC) OUTPUT 1 in MACH is used to turn on the TORCH Relay located out in the THC SENSOR PWM. Operation is covered in depth in the DTHCII User Manual but it is easy to simply plug in the THC SENSOR PWM module to the DTHCII module using the 25ft UTP Cable and test the TORCH ON by toggling the TORCH button on the Diagnostics Screen and watching the TORCH LED on the front of the THC SENSOR PWM module. You can test the other two AUX outputs by plugging in the AUX AC cable and plugging in an AC load (table lamp, 120VAC FAN . etc) and toggling the individual outputs on and off.

The AUX outlets can also be turned ON and OFF from G-code using an “M” command. What M command is used to turn on/off an OUTPUT is a setting in MACH and comes defaulted so a M03 or M04 turns on OUTPUT1 (Torch on the Plasma Profile, Spindle on the Router Profile.) M05 turns OFF either. In a full Spindle Speed System the M04 turns ON the REVERSE RELAY.

The two AUX Relays (See Setting Outputs Section) are located on the TABLE I/O.

Control OUTPUTS from DIAGNOSTICS SCREEN via the Toggle Buttons for each output,

NOTE: Only 3 Outputs are availaible on a BladeRunner AIO Dragon-Cut (Large buttons above). The Router setup only has 2 outputs available.



Diagnostics Screen allows you to LOAD and RUN G-CODE files and to see the scrolling G-CODE. To load a G-Code file move to the top tool bar and FILES/Load GCode and select the file to load. It will appear in the G-Code window. There is a small Toolpath display under the G-CODE window and the dispaly can be turned ON/OFF with the buttons under it.

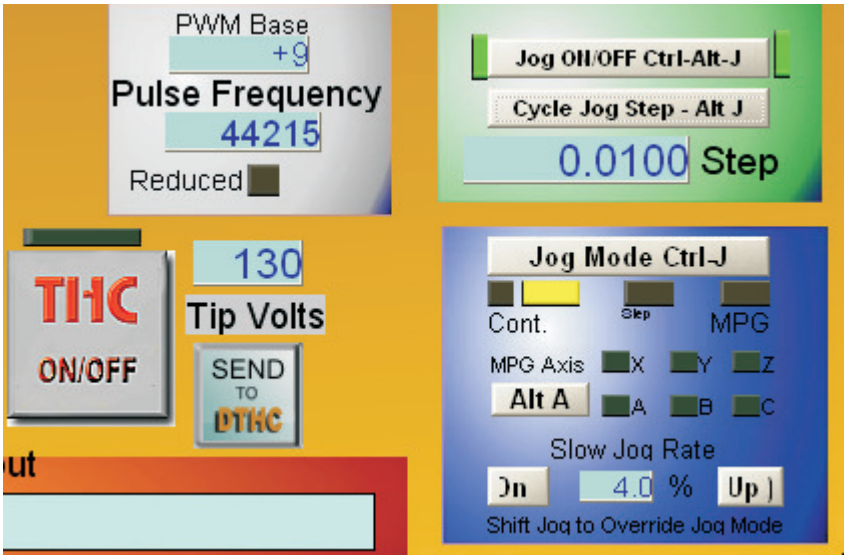
To RUN, Feedhold, STOP, Rewind of SINGLE STEP from the Diagnostics Screen use the Buttons shown.

There are status LED's for UNITS and to show running status and Dwell.

USING SINGLE STEP TO TROUBLESHOOT CODE:

Often a mistake in G-Code or the setup is hard to spot because it runs faster than you can watch the machine and the code execute. The SINGLE STEP can help with that. It puts MACH in "Single Block mode" which means it will execute ONE LINE (block) of G-Code at a time. It does this by clicking the RUN button each time you want the next line of code to execute. On a plasma we recommend you turnoff the plasma and disable the AUTO THC ON (Cut Profile) before using the SINGLE button. With the SINGLE Button on (LED ON) you can run a line, watch the moves, take a measurement if needed and see if the motion is correct.

Other things you can control from the Diagnostics Screen:
1. JOG ON/OFF (unusually left ON)
2. Set the SINGLE STEP Jog Increment (Cycle Jog Step)
3, Change the JOG MODE from CONTINIOUS to STEP. STEP MODE only moves the axis the JOG INCREMENT each time you hit the Jog button.
4. Change the SLOW JOG rate (no SHIFT with a JOG KEY = Slow jog). You can use the UP DOWN buttons or type in the value in the DRO (hit enter to “SET” the value)
5. Turn the THC Logic in MACH ON/OFF
6. Enter a new TIP VOLTS (PRESET VOLTS) value [Enter Key to Set] and then SEND to DTHC (change the running value in the current DTHC configurations

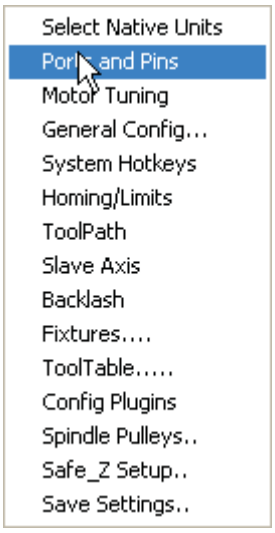


While most of the controls are on the Program Run Screen of MACH the DIAGNOSTICS SCREEN lets you monitor inputs/outputs and position while running manually or via code. While there is a lot of information and buttons it offers the feedback you need when doing the intital setup or troubleshooting of a system. Earlier in the PC Hardware Section you see how the RAW PORT INPUT BITS shows if the Parallel Port is properly configured and respondiing.

SETTING UP MACH3 FOR BLADERUNNER

When you install the BladerunnerAIO-UBOB3-Install.exe file (auto installer) it automaticaly sets up two profiles in MACH, One for Router and one for Plasma with DTHC interface. The following pages will go though how to test and change any of the default settings for your specific table.

There are several sections of the MACH CONFIG that we will cover. The access the MACH3 direct configuration menu find the TOP Menu on the screen and click the CONFIG select in the Drop Down Menu



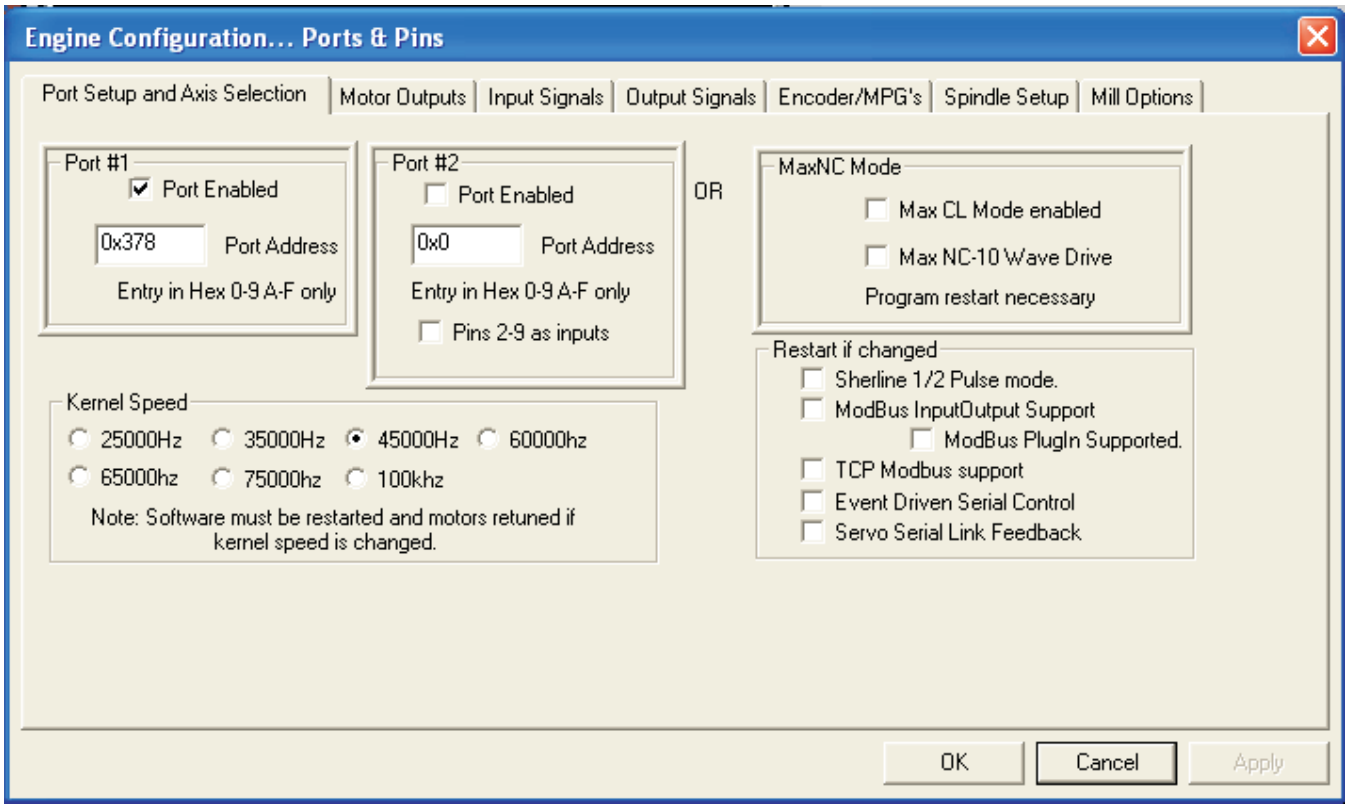
The selections in the CONFIG Drop Down Window (DDW) consists of several sections. Most of them are not used setting up a BladeRunner Profile. If you don't know what a function is DO NOT change it unless you make a copy of your Profile and perform the changes on it. Making changes to see what it will do is dangerous because cetain settings are critical to the full operation of UBOB III.

A note here about configurations and MACH3

The config menu is a user interface to make changes to the current MACH3 PROFILE you are running. Each Profile has it's own file with settings. Virtually every setting is stored in that PROFILE. Things like Motor Tuning, Ports & Pins and even which Screen Set it uses are stored. If you make a change in one profile it DOES NOT propagate over to another profile's settings!
If things get really messed up you can reload from the INSTALL file off the CD but if the PROFILE name is the same then the settings go back to the Defaults. Each time you make a change in CONFIG it gets stored in an XML file with the same name as the displayed Profile in the Program Run screen. IT ONLY SAVES THE RUNNING PROFILE WHEN YOU CLOSE MACH NORMALLY. MACH only reads the Profile when you start it up to a specific profile. Some settings will change the RUNNING profile (what you are currently running) OTHERS DO NOT. Plugins are only read once when MACH is started so a chage to a plugin config will require you stop and restart MACH3.

CHECKING MACH3 CONFIG for Proper PORT1 ADDRESS

In the PC Hardware Setup Section the PORT 1 Address was determined. Use the CONFIG/Ports&Pins menu to check the address and if needed change the settings. Note PORT #2 is disabled. Default Kernel Speed is 45000HZ which will work with most PC's and will provide pulse rates for any BladeRunner setup.

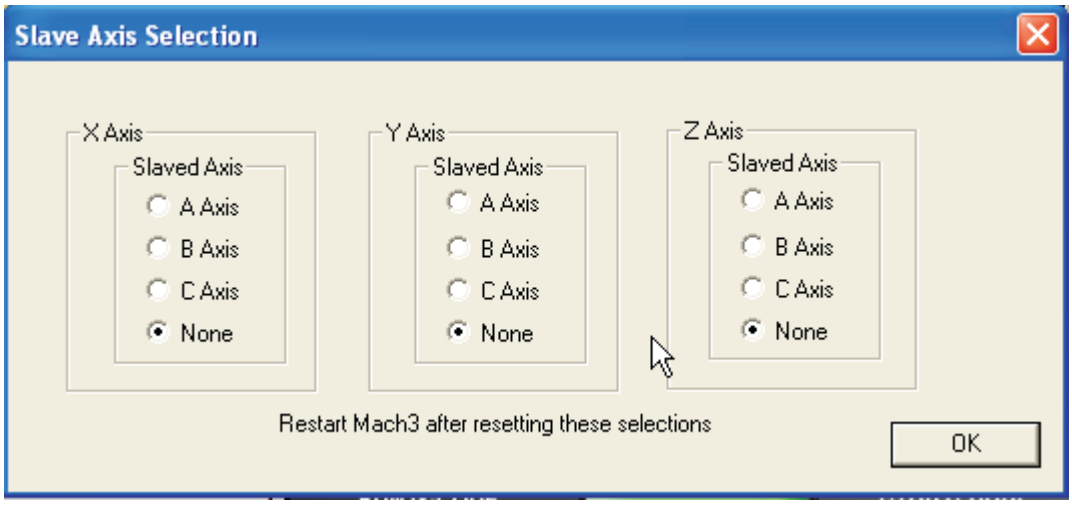


CHECKING AXIS MOTION (4 Motor systems)

Setting up the Software Slaved Axis. BladeRunner 300-4 and 620-4 are shipped with 4 motors but **the A axis is NOT SLAVED in the default setup**. You will need to decide the axis naming convention you will be using for X & Y. There are several schools of thought here. The old convention is to call the "long" axis X and the short axis "Y". This can make for some confusion as to how to layout files to be cut if the operator station is not facing perpendicular to the long axis. Our approach has always been to use the computer screen layout where the vertical (UP and Down) on the screen is Y and the horizontal on the screen (side to side) is X. That is the way the software will want to designate the axis on the computer by default. In the following pages we show typical setups and operator position. The goal is to have the toolpath oriented the same way as it shows on the computer drawing in relation to where the operator stands at the table. The recommend placement of HOMES is based on the fact that normally the lower left corner of the drawing is defined as the 0, 0 (origin) of the drawing and the resulting G-code from the CAM if it follows the same convention.

- NOTE: IF YOU HAVE A 4 MOTOR SYSTEM, the A axis should be software slaved to the axis you have designed as the Gantry motion axis (X or Y). We do not have that setting as a default because we do not know which axis you will designate as the gantry motion axis.

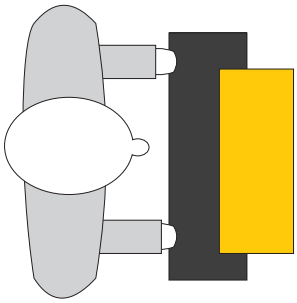
To slave the axis in software: Open MACH3 CONFIG/AXIS SLAVING



Select the Axis you wish to slave the A to (X or Y and click the A radio button on that axis.

If you have a 5 motor system. A 5 axis slaved (sometimes called a 4.5 system) Hardware slaves the 5th motor/driver using settings on the UBOB card. Factory default is for the 5th axis to be slaved to the Y motor and turn in the opposite direction. The above Slave Axis Selection is set to None on all axis (no slaving). The A axis then is independant and is activated for testing with the numeric pad + and - keys by default.

Set your table and control console up so you cut in the same orientation that you draw in where side to side is always X



If you stand here to run the machine then 0, 0 is lower left corner from your location. X is cross axis (long axis)

X axis

X, Y Homes
0, 0

Typical rectangular table setup

4 motor setup (dual drive on the gantry)

Z axis w/ torch holder

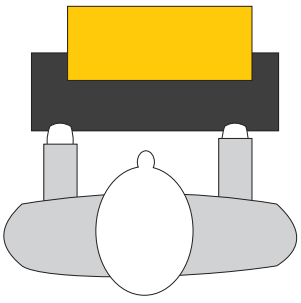
Master Motor

GANTRY

Slave Motor

Z axis w/ torch holder (alternate mounting)

X, Y Homes
0, 0



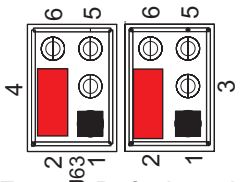
If you stand here to run the machine then 0, 0 is lower left corner from your location. X is cross axis (short axis)

X axis

Hardware Slaving Options.

ONLY USE THIS PAGE IF YOU HAVE A 5th AXIS CARD INSTALLED or INSTALL ONE LATER
Even if you decide not to use the 5th axis **the unit is shipped from the factory setup to use the 5th axis as the default Slave axis (HARDWARE SLAVE)** If you decide NOT to use the Hardware Slave and instead want to use the A axis as a software slave then YOU MUST break the Hardware Slave using the Jumper Settings below. If you elect to ignore the instructions and leave the settings as a Hardware Slave and try to use the A axis hardware slaved also, **you will get DRIVE FAULTS on the (unused) 5th axis.**

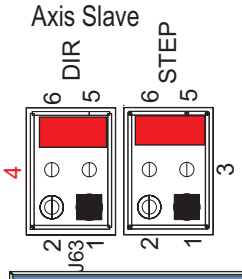
4 AXIS SYSTEM
FACTORY DEFAULT



Factory Default setting if 5th axis not used. Do not change unless you are going to use a 5th driver and motor.

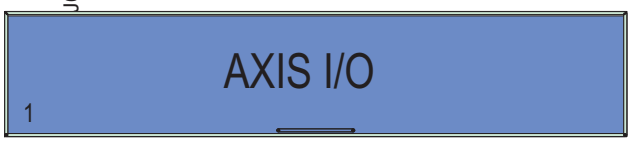
5 AXIS SYSTEM
FACTORY DEFAULT

Hardware Slave shown in "Y" Position

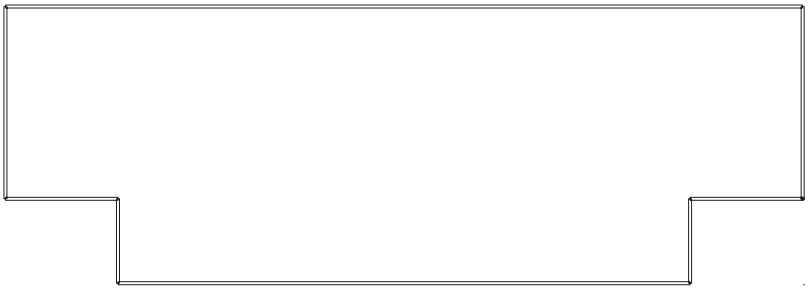


Both OPTION BLOCKS MUST be jumpered the same.

1-2 External drive FROM PORT2 card
3-4 Slave 5th Axis to X
5-6 Slave 5th Axis to Y



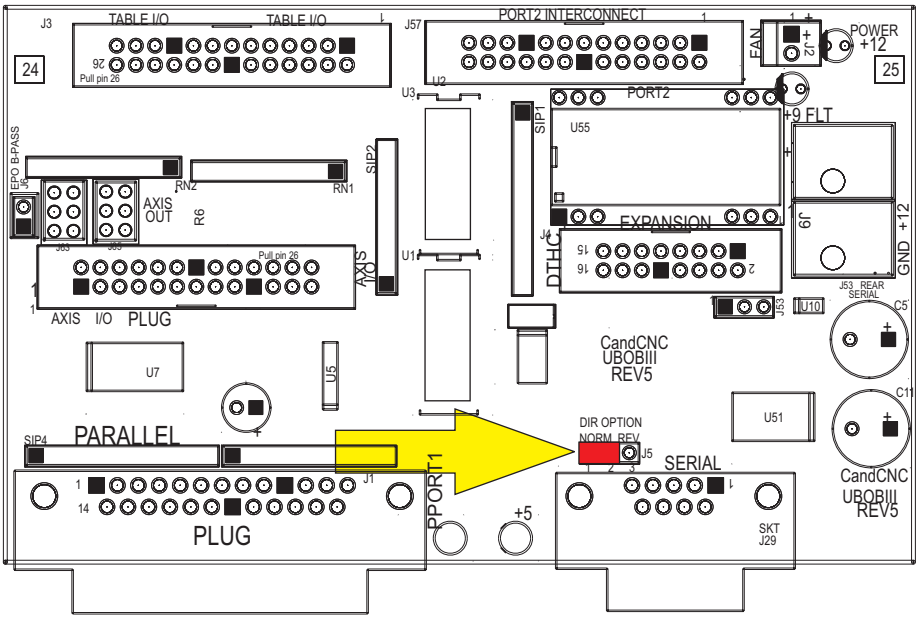
In order to run 5 separate (independant) axis (not hardware slaved) you have to install and setup a 2nd parallel port card in your PC and interface it through our OPTIONAL Port2 Interface Card. See the addendum section for information about the Port 2 Interface



THE UBOBIIII card in the drawing is located in the Top of the BaldeRunner AIO unit, The PORT1 and COM1 connecors stick through the apnel on the right side of the enclosure, see the photo on page ___tp locate the UBOB Card

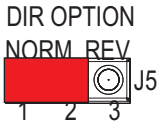
ONLY USE THIS PAGE IF YOU ARE GOING TO DRIVE A 5th MOTOR FROM THE MTA150 Card. or in the BladeRunner It sets up what that output (B) does. If you want to SOFTARE slave an axis that is done in MACH3 in the Axis Slaving under CONFIG.

See previous page for Hardware slaving option jumpers



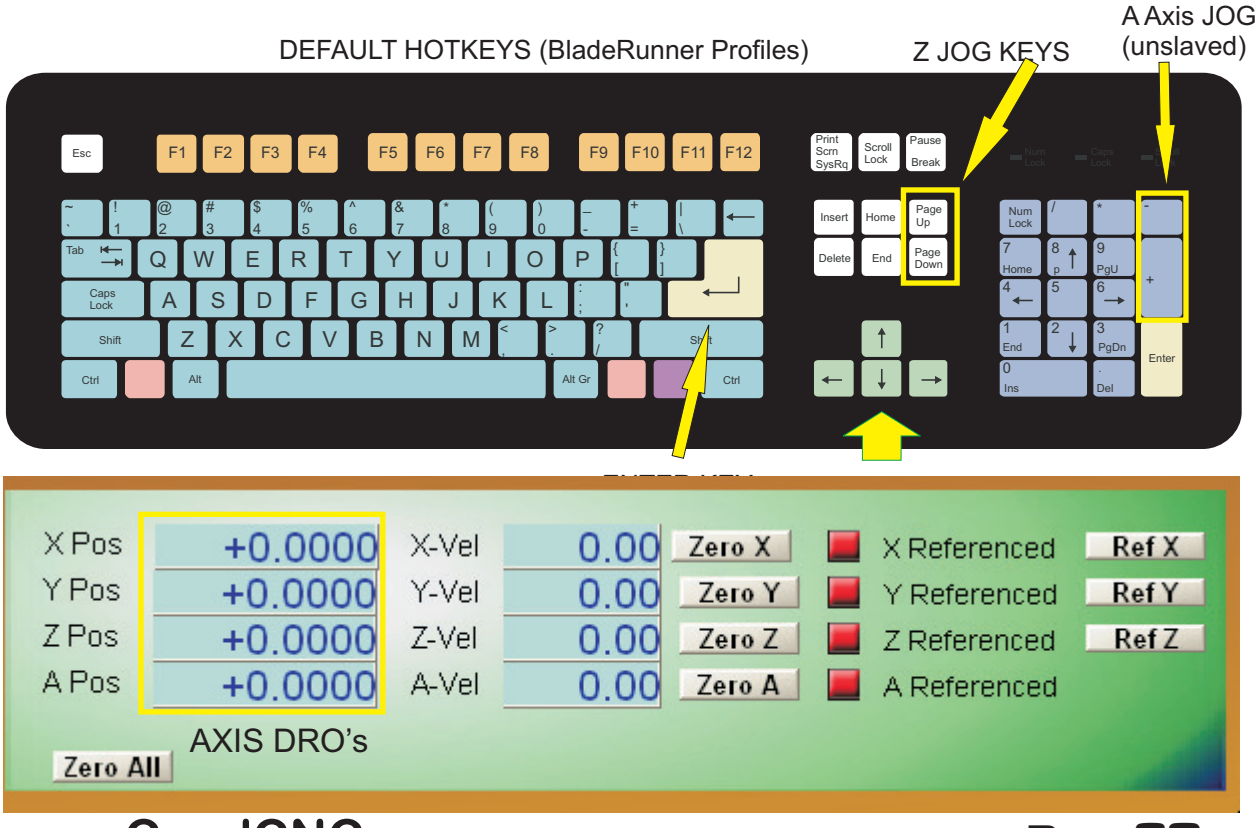
DIRECTION POLARITY JUMPER
(New on UBOBIII REV5 cards)

This option is used ONLY if you are hardware slaving the 5th axis option from the X or Y. It allows you to change the direction of rotation of the 5th motor if needed. You can reverse a stepper direction at the motor simply by swapping the polarity of one coil (out of the two) Wile that works for steppers you cannot reverse the direction of a servo that way. We have added the Direction Polarity Jumper to allow you to reverse the DIR signal polarity in hardware. To reverse the direction simply move the jumper from 1-2 to 2-3 position,

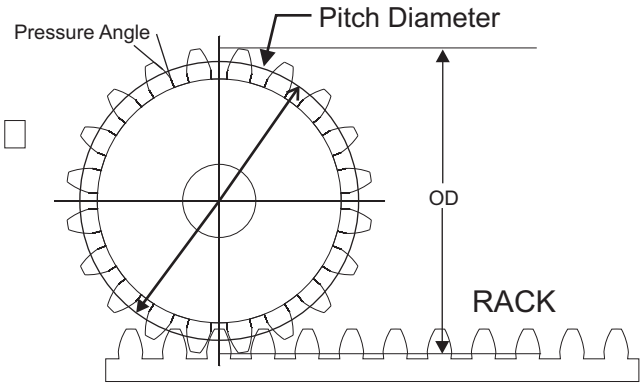


INITIAL MOTION CHECK:
After you have powered up the BladeRunner and checked the power on sequence and checked the motors on each axis the next step is to plugin all motors and run an intial motion check. You can wait to do this after you get the motors mounted on your CNC table if you want or you can set the motors on the table oriented like they will be mounted to check inital motion and direction.

1. Make sure the PC connections have been made and the PC Hardware ports setup as per previous sections.
2. Plug in all the motors. Orient them like they are going to be mounted. Label them if they are not on the table.
3. Turn on the main power switch on the end of the BladeRunner ESPII box.
4. Turn on Motor DC using the Front Panel ON (White) button.
5. Check to make sure the motors “lock” and that you have a Green ON LED
6. Start MACH3 with the plasma or router profile (desktop Icon).
7. Switch to the DIAGNOSTICS TAB in MACH
7. Jog the axis in turn using the keyboard Jog keys
    a. Left and Right Arrow --> and <-- should jog X axis
    b. Up and Down Arrow should jog Y axis
    c. PageUP and PageDown should Jog Z axis
8. STOP! If you cannot get an axis to move or or it only moves in one direction:
    a. Check to make sure the associated DRO is changing on the screen
    b. If it is then check all of your cables from the parallel port
    c. If you have DRO action and still fail to get motion in both directions, turn to the Service Manual Section. See the section on troubleshooting port problems.
9. If you have motion on all attached motors then proceed to the next section



LINEAR MOTION WITH RACK & PINION



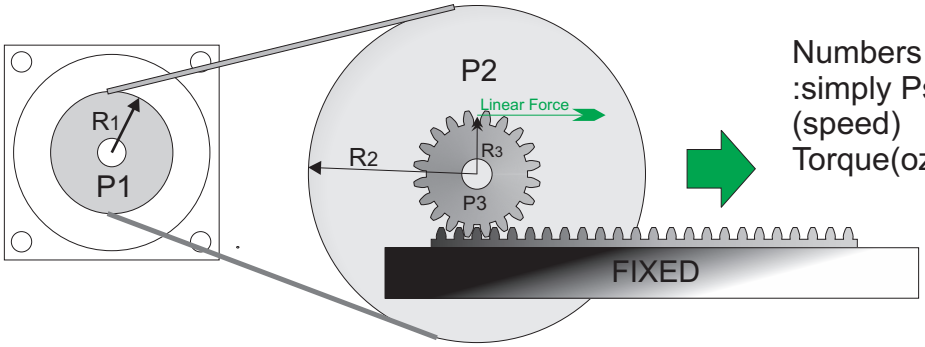
TYPICAL SPUR (PINION) gears
Psr = Pinion Speed increase ratio = Pitch Dia [in inches] * PI (3.1416)/1
= Pitch Dia [in mm] * PI (3.1416)/25.4

Example: 1" Pitch Dia pinion will have a step up ratio (speed increase of 3.14 (approx 3)

Belt reduction decreases speed by Raw Speed /Belt Reduction Ratio
Belt reduction increases linear force by normal force X Belt Reduction Ratio

Raw Motor Resolution = 1/200 = .005" linear [.127mm]
Final linear resolution = .005/Belt Reduction Ratio

Belt Reduction Ratio =
R2/R1



Numbers for direct pinion drive are :simply Psr * Motor RPM = IPM (speed)
Torque(oz) = T1/ R3

Forces:
T1= Rated motor holding torque (Oz-in) / R1
T2 = Shaft holding torque of P2 = motor holding torque * Belt Reduction Ratio
T3 = Torque(oz-in at pinion (teeth) = T2 * R3

Note: Motor torque decreases with Motor RPM so a number of about 50% of the holding torque

Motor constants: (based on stepper motors provided by CandCNC)
Typical RPM of hybrid steppers (moderate load) with different DC power
24 VDC = 300 RPM
48 VDC = 600 RPM
65 VDC = 800 RPM
Number of steps for 1 motor REV = 2000 (this a fixed number based on Microstepping X10)

EXAMPLES

620 oz-in Stepper motor @ 48 VDC with 1” dia pinion gear & direct drive:
Max possible IPM = 600rpm X 3.142 = 1885 IPM

* 50% RPM linear force = 50% Stepper motor torque / pinion Radius/ Pinion Speed Ratio = (310Oz-in/.5in) / 3 = 206.66 linear oz of force

Same design but with 3:1 belt reduction from motor to pinion shaft:

(310OZ-in/.5in)/1 = 620 linear oz linear force.

* in the above calculations the motor RPM and torque numbers of 50% were used to operate the motor in the center part of it’s torque-RPM curve.

Calculating the beginning Steps per UNit on an AXIS

Use the following formala to get a ballpark steps per unit number in MACH

Psr = Pinion Speed increase ratio = Pitch Dia [in inches] * PI (3.1416)/1

Target Steps per Unit = (Psr X 2000)/Belt Reduction ratio

This will give you the required number of steps it takes to move 1”

Once you have the calcualted number of steps it takes to move the axis one inch then put that number into the STEPS per UNIT of the motor.

Based on the speed numbers you have calculated from the previous pages set you velocity to a vlaue of 60 to 80% of that number.

Set your Beginning Acceleartion to a low number like 10

To fine tune the calibration see the next pages.

Setting the initial Steps per Unit in MACH3 motor tuning.
Every table will have different Steps Per Unit, Velocity (max speed) and Acceleration settings. To do testing on the table you must determine the correct settings for your table. Use the following method:
For Steppers:

1. Determine the number of steps your motors need to make one full revolution (Normally 200 for most steppers)
2. Multiply by the Motor Driver microstepping rate (10 for BladeRunner/Gecko drivers) = 2000 steps for one motor revolution.
3. Determine the drive ratio of your mechanical drive (how far does the leadscrew or pinion move the load with one revolution of the motor).
4. Convert everything to you Units (inches/millimeters) and same time measurements (seconds or minutes)**.**

Using 1 and 2 above we know we have to send 2000 pulses (step pulses) from MACH to rotate the motor **one complete revolution** (360 Degs).

The rest of the math is based on the transmisson ratio(s) between the motor and the final drive element. If it's Rack & Pinion you need to know the DP (diametric pitch) or the tooth count of the pinion gear and the TPU of the Rack (Teeth per unit)
If it's a direct drive leadscrew you need to know the treads per unit (TPI for inch units)

We have to determine how far the load moves (in units) for each REV of the motor.

Lets do a direct drive leadscrew of 5 TPI :

It takes 5 turns to move the load one inch of linear movement so the steps per inch (unit) of the axis is simple: 2000 [number of steps for one rev] X 5 [number of Rev to move one inch] = 10.000 steps per inch. (.0001") resolution. About 6 to 7 times the torque. 1/5th the motor Speed.

Now let's do a R & P direct drive and an R & P with a belt reduction transmisson:

For a R & P the distance traveled per rev of the pinion is given by the DP of the pinion X PI [3.1416]. Ifwe use a 1" DP pinion the distance traveled is 3.1416" per rev of the pinion So a direct coupled motor gives us over 3" of travel per rev. To get it back to a Unit (1 ") it would be the number of steps (2000 from above) / 3.1416 or 636.6183….as you can see, the resolution at .00157 per step is MUCH courser than the 5 TPI leadscrew. The max velocity (speed would be over 8 times the leadscrew but with 1/3 the torque of the motor specs) is over 2000 IPM.

To gain back the lost resolution and torque you should belt reduce between the motor and pinion. With a 5:1 ratio you would see the numbers change to:

2000 /3.14165 X 5 or 3183.1 steps per inch (.000314 inch). Torque would be 1.66 times greater than motor rated torque.

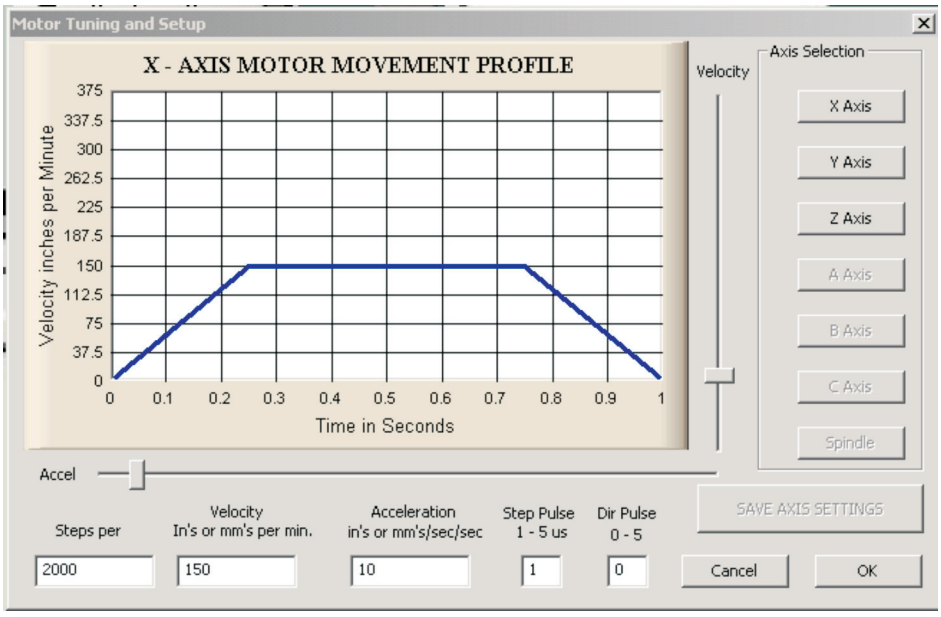
NOTE: DO NOT use the microstepping in a "true" resolution calculation for *accuracy*. Microstepping is for motion smoothness and cannot be counted on to actually position the motor shaft at a fraction of a motor pole (between poles). It can be off and the faster the motor spins the less effect microstepping has. The only true resolution will be the 200 steps per rev of the motor. In practice it will be somewhat better especially at slower RPM but it varies.

For proper tuning of MACH3 please refer to the MACH 3 manual. The exact tuning of the software is beyond the scope of this document.

Motor Tuning Screen in MACH3

Testing the BladeRunner for motor control
. In order to get motion and you need to have MACH3 running with it out of E-stop and the CP LED on the front panel active (ON). Without CP active, you will not get motion.

- Make sure all of the cables are connected.
- Power up the BladeRunner
- Load Mach3 with the proper profile (BladeRunner) and Screen
- Turn on DC Motor power using the ON button on the Front Panel
- Motors should “lock” when power comes on to the motors
- Hit the Reset button. The LED over the Reset in MACH will turn solid Green
- The CP LED on the front panel of the BladeRunner will turn solid Yellow
- Use the keyboard arrow keys to jog your machine. Don't worry if they jog the wrong way with the keys or the wrong axis jogs. We will fix that later.
- The Optional test Step and Direction Monitor will confirm that the signals are getting out to the EzPlug G251-4 Driver card. If the LED's flash and you are not getting movement the problem at and the motor drivers. Check your cables and connections carefully. The DB connectors need to be seated and the holding screws tightened for each cable. Sporadic motor movement or direction changes (without changes at the Step & Direction Monitor indicates one winding on a motor may not be making good connection



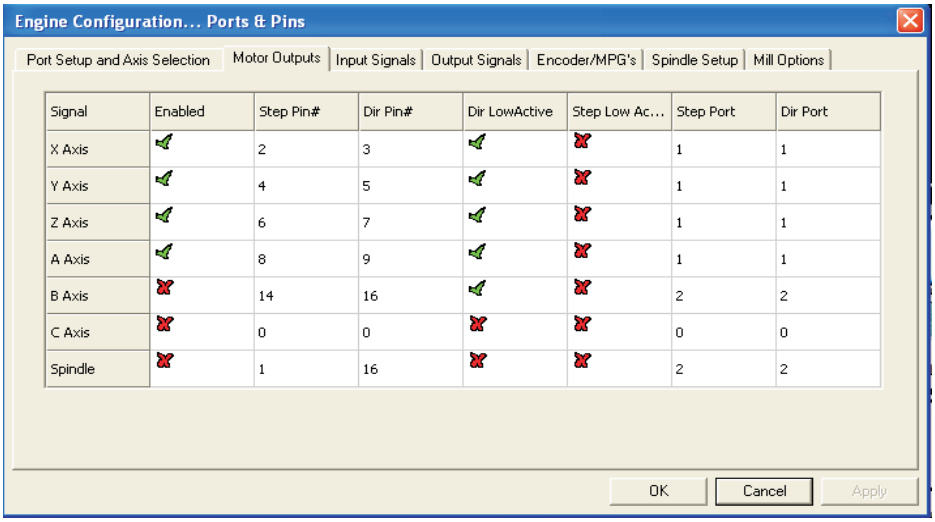
SETTING MOTOR DIRECTION

At this point you should have motion on all axis using the Keyboard keys to scroll with. In this section we will set the direction of motion for each axis and match the keyboard keys to that motion.

IF YOU HAVE THE MOTORS ON THE BENCH AND LABELED YOU WILL NEED TO ORIENT THEM LIKE THEY WILL BE MOUNTED ON THE TABLE AND WATCH THE DIRECTION OF TURN OF THE SHAFTS. IF YOU DECIDE TO MOUNT THE MOTORS ON THE TABLE YOU SHOULD DISENGAGE THEM FORM THE TRAVEL MECHANISM UNTIL YOU GET ROTATON DIRECTION RESOLVED. THIS IS ESPECIALLY TRUE FOR THE SLAVED MOTOR ON THE GANTY AXIS

1. Load MACH and the BladeRunner Plasma or Router Profile
2. Load the Diagnostics Tab
3. Power up the BladeRunner AIO and the DC to the motors
4. Move Each axis several inches away from the Table 0 (home switch) positions5. Zero each DRO with Zero Button next to each axis.
5. Jog the Z first. Note the Z DRO as it moves UP.
    a, If the numbers are INCREASING in value then the direction is correct.
    b. If the numbers are DECREASING then the DIR is wrong. See the next page to change the DIR of a motor
    c. The key may not match the direction of jog...do not worry it will be redefined
7. JOG the non-slaved axis next and do the same DRO check and change if it is scrolling the wrong direction.
8. The Slaved Axis is a little different. You must FIRST setup the slaving (See Page ___ earlier in this section) using the 4 axis or 5 axis instructions.
9. The DIR setting on the **SOFTWARE Slave** (A is slaved to Master axis) is opposite the Master axis (motor faces the other and spins opposite to move the same direction) **Hardware Slaving** is set via jumper on UBOB III
10. If in the setup you need to change the Master Axis DIR to make it move correclty you will also need to change the Slave Axis on a 4 axis (Software Slave) setup.

Setting up the proper axis direction and motor tuning
While the Profile file (BladeRunner.XML) provided with the unit sets up all of the pins there are several things we don't know about your machine and so certain parameters have to be set based on your specific machine. .



Signal	Enabled	Step Pin#	Dir Pin#	Dir LowActive	Step Low Ac...	Step Port	Dir Port
X Axis	✓	2	3	✓	✗	1	1
Y Axis	✓	4	5	✓	✗	1	1
Z Axis	✓	6	7	✓	✗	1	1
A Axis	✓	8	9	✓	✗	1	1
B Axis	✗	14	16	✓	✗	2	2
C Axis	✗	0	0	✗	✗	0	0
Spindle	✗	1	16	✗	✗	2	2

Note each axis has a Step and Direction pin.
At this point do not worry if the axis moves in the wrong direction, simply that you have the axis as you define them correct.

The next step is to make the axis movement agree with the DRO and g-code commands for that axis. The DRO (Digital Read Out) for each axis is at the top of the screen. You will need to take MACH3 out of E-stop by pressing the Reset button.

- Jog your machine so the cutting head is away from the Homes (approx center of the table is good). Don't worry if the jog keys aren't correct or that the DRO's are running in the wrong direction.

- If your machine is setup so that one corner is X0,Y0 (lower left corner?) then **all** moves from 0,0 should be a positive number.

- The MDI is a line to allow you to type in direct g-code commands to make the machine make specific moves. You don't need to have a deep knowledge of g-code to use it for testing.

Diagnostics Tab

(Your MDI may look different)

- When you type in a g-code command it is not case sensitve but be sure to use zeros's and not "O's" for the numbers! **At this point do not worry about which hotkeys are assigned to a direction**.
- With the machine out of e-stop and power on, type the following into the MDI Frame:
  - Move the screen cursor to the MDI frame and click on it. The frame background color should change to yellow meaning it is ready for input. No other movement keys work when the MDI frame is selected.
  - G00 X3.0
  - Enter key activates command
- The X axis should move 3 inches in some direction It should have moved away from your established X zero and the DRO numbers should have increased. If it did not then you need to reverse the direction of axis travel.
- To reverse the direction of any axis open the Ports and Pins/ Motor Outputs and change the polarity of the **Dir LowActive** setting for that axis. Clicking the Green Checkmark or the Red X will swap the definition. Red X is posiive and Green Check is negative polarity.
- Work with each axis to establish that the movement direction is correct. Use the MDI frame and change the axis letter from X to Y then Z. **Do NOT change the polarity of the step signal (Should always be Red X for BladeRunner**

FINE TUNING the calibration using the "tape measure" method

Once you have a ballpark of the number of steps it takes to move your machine 1 inch then you can fine tune that using a simple tape measure and a calculator

1. Establish a zero spot you can precisely mark on your table. On a plasma table you need to remove the torch and either mount a laser pointer at tool center or use a sharp pointed tool in a holder. You can also tape a small drill bit or pointer to the torch nozzle if your mount has enough room. You want something small enough you can see errors of .032 on the marks of the tape.

2. Setup up the axis you want to calibrate with the pointer sitting at the zero point and zero that axis DRO.

3. Write down the Steps per Unit value you have for that axis.

4. Open MACH to the Diagnostics Page and find the MDI window

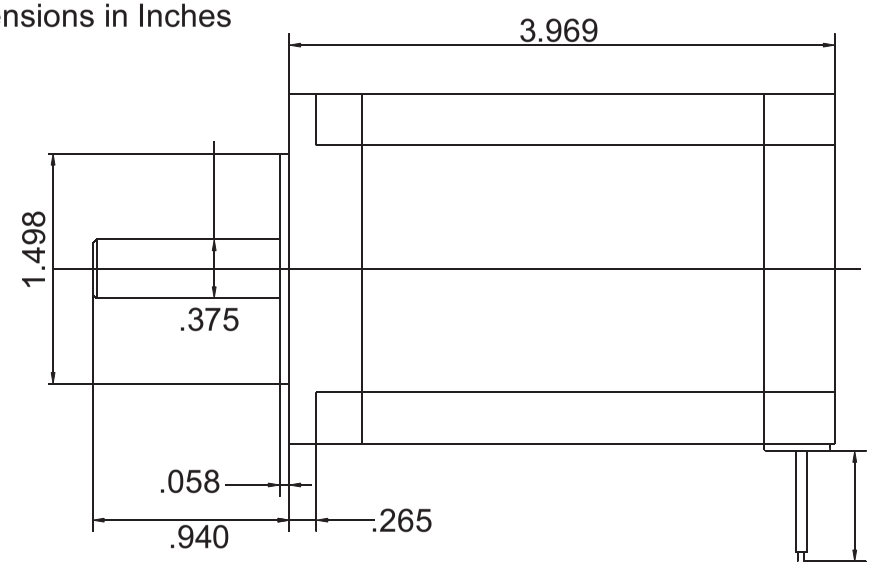
5. Type in a distance to send that axis out using the following G-Code (example is for moving X out 30 inches) **HIT THE ENTER Key to execute the line**

6. Measure the ACTUAL distance you went with your tape measure from zero to where it stopped and write down the distance to as close a decimal value as you can (estimate the distance if it's less than a 1/16 (.063).
7 **BEFORE YOU make ANY changes** move the axis back to the start point by using the MDI and typing G00 X0.000 (for the example above)
8, Use the formula On the next page and calculate the new Steps per UNIT. Then open the motor tuning in MACH and make the change. Run the same test again (you should be MUCH closer. Once you are as close as you can see by eye at 30 inches do one final test at the longest point on that axis. Typically if you are within .032 at the end of the move, you will be within 4 decimal points at 1 inch.

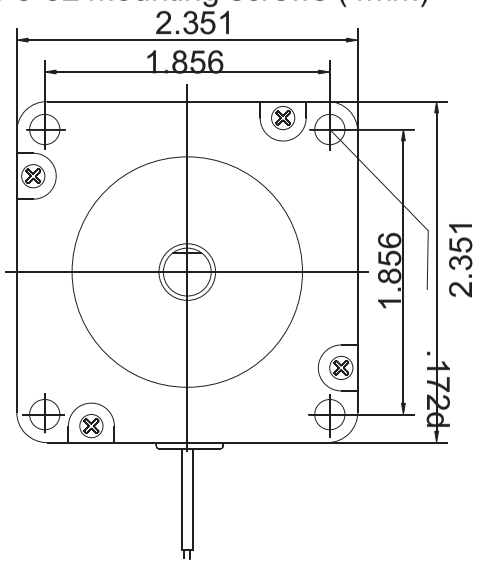
BladeRunner 620 Stepper Motor
Dimensions

☐ *DIMENSIONS*

Dimensions in Inches



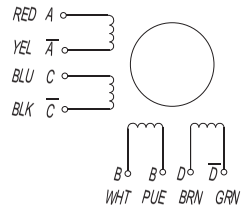
Use # 8-32 mounting screws (4mm)



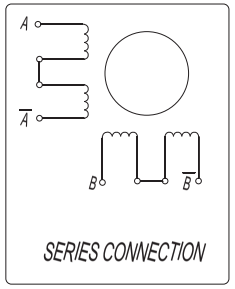
☐ *SPECIFICATIONS* unit=mm

CONNECTION WISE	*EIGHT WIRING*	*SERIES CONNECTION*	
PHASE	*2 PHASE*	*2 PHASE*	
STEP ANGLE	*1.8±5°/STEP*	*1.8±5°/STEP*	
VOLTAGE V	*3.5 V*	*5.0 V*	
CURRENT	*3.5 A/PHASE*	*3.5 A/PHASE*	
RESISTANCE	*1 ±10 Ω/PHASE*	*2 ±10 Ω/PHASE*	
HOLDING TOGQUE	*400 N.cm*	*437 N.cm*	
INSULATION CLASS	*B*	*B*	
LEAD STYLE	*FF46-1/0.5*	*FF46-1/0.5*	
NO. OF LEADS	*8*	*4*	

☐ *COLORS OF LEAD WIRES* *BIPOLAR & UNI-POLAR*



EIGHT WIRING CONNECTION



SERIES CONNECTION

TAG	PLACE	CHANGE	NAME	DATE
DESIGN		STD.		
CHECK		APPROVE		
PROC.				

DESIGN	MASS	PLATE	SCALE
NR			

[redacted]

CandCNC

FORMULA FOR CALIBRATING
Steps per Unit on an axis

Steps per unit in MACH

Current Setting in Steps per UNIT = Sc
Actual Distance Traveled = Dt
Commanded Distance (you entered) = Dc
New Steps per Unit value = Sn

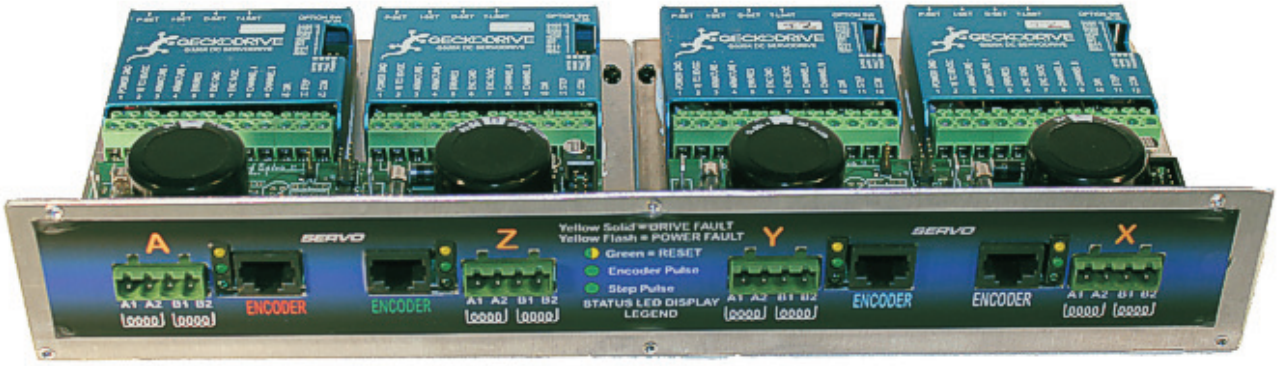
(Sc X Dc)/Dt = Sn

Sn is in steps and will probably a decimal number
Set the decimal amount to 3 decimal places

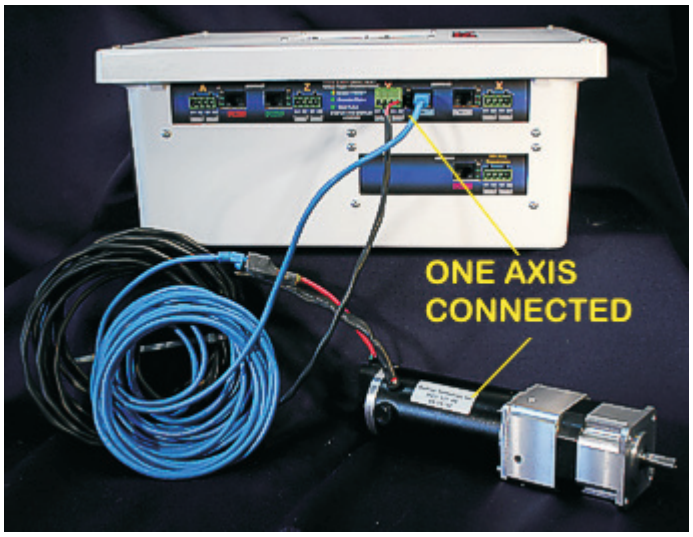
ADDENDUM SECTION ADDED 11/15/12
For BladeRunner AIO Dragon-Cut SERVO products

The following 6 pages are for the SERVO motor version of the BladeRunner Dragon-Cut and cover the setup and tuning of a system with servo. The Drive tuning is done at the factory and seldom needs to be changed but some mechanics may require some tweeks to the driver tuning. Besides the change of the tuning in MACH (calibration) and recommended settings for the servo system the Dragon-Cut will operate in the same manner. The motor gearhead combinations were engineered for optimum performance for plasma cutting. The wider torque range of the servo motors provides a better platform for mixed cutting applications (router/plasma) but the typical issues of cross contamination and change over still remain. The Servo system does offer higher performance with increase upper cutting speeds at high acceleration rates. This does put larger stress on the mechanics so full out maximum settings are often counterproductive.

HARDWARE DIFFERENCES for BladeRunbner SERVO system



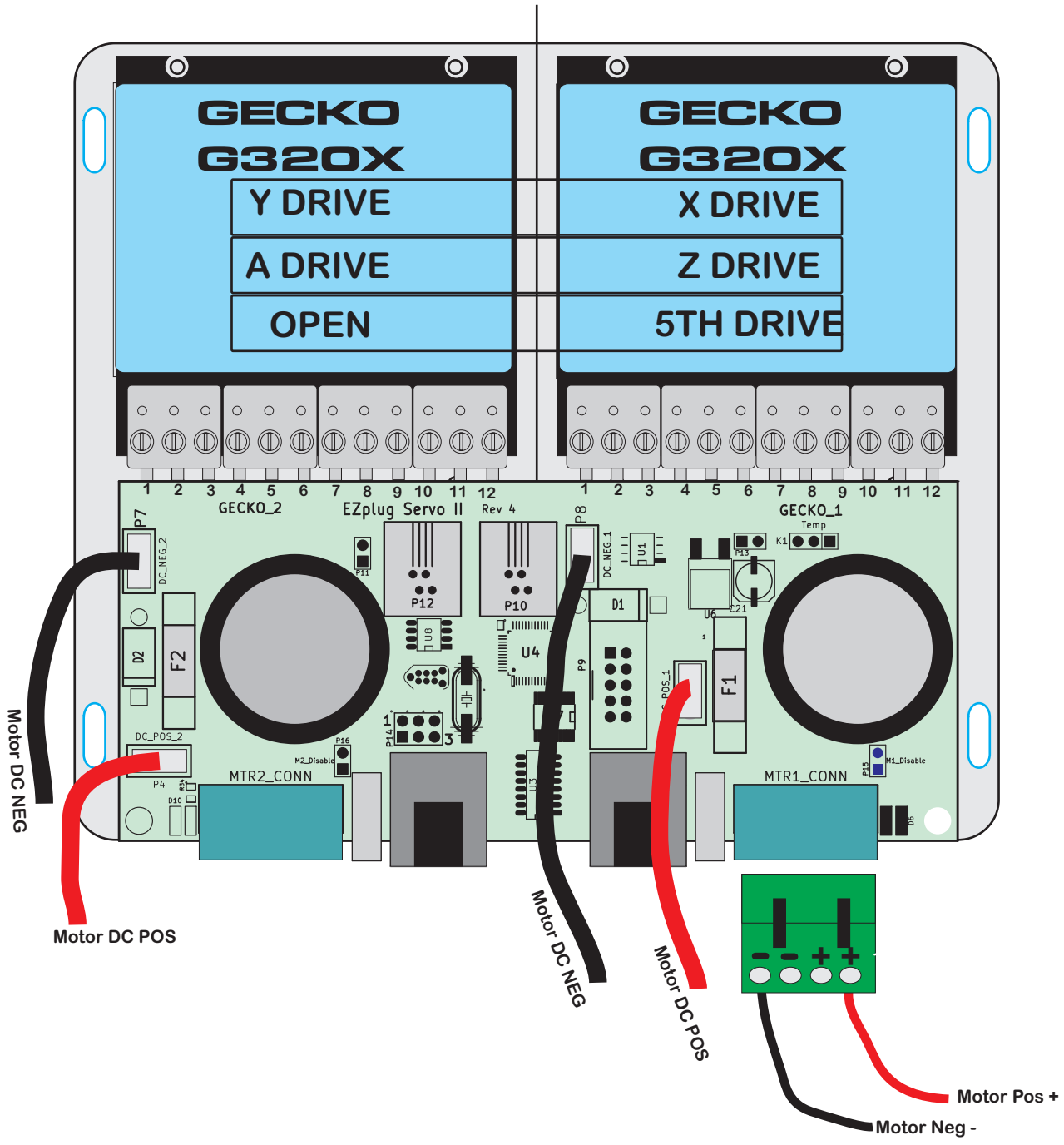
EZPlugII Servo Drive Assembly



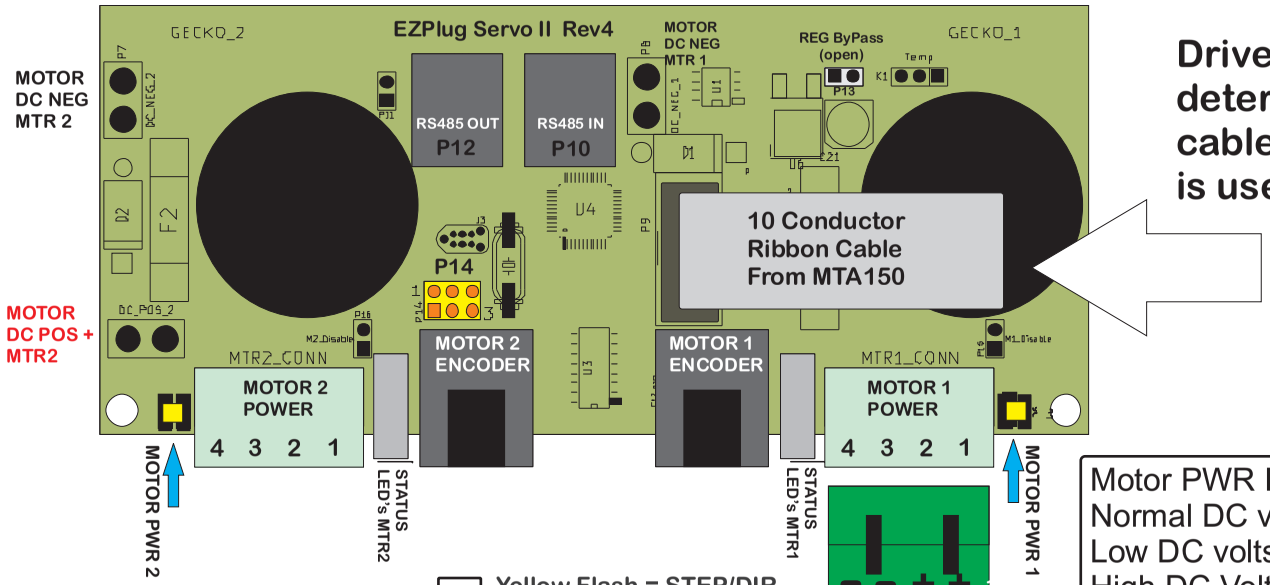
NOTE: Servo Motors use the same 4 wide motor plug as the BladeRunner Stepper systems but the pinout is different. Do NOT plug a stepper into a servo unit or vive versa!

SERVO systems use a rotary encoder mounted on the motor. Each encoder is supplied with a differential driver ("pigtail") that allows a standard CAT 5 cable to be plugged in and transmit the encoder information back to the servo interface sub-assembly. you MUST HAVE THE ENCODER CABLES CONNECTED when a motor is powered up! With no feedback to the electronics of where the motor is it will "Run Away" We have color coded the label and the cables to make it easier to identify each motor/encoder pair. Do not get the pairs mismatched/ The Inputs from the PC parallel and serial port are connected the same way as the stepper version as is the DTHCII connections (see DTHCII User Manual

EZPLUGII Dual Wide Servo Interface Assembly

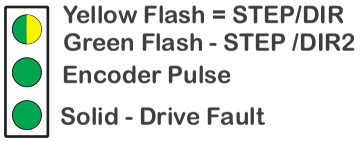


EZPlug II Servo Interface Card



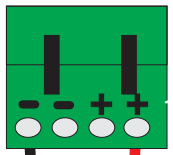
Drive pairs are determined by which cable from MTA150 is used in P9

Motor PWR Indicators:
Normal DC volts = steady ON
Low DC volts = Slow flash
High DC Volts = Fast Flash



Yellow Flash = STEP/DIR
Green Flash - STEP /DIR2
Encoder Pulse
Solid - Drive Fault

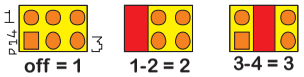
STATUS LED DISPLAY LEGEND



Motor Pos +
Motor Neg -

REF NUM	Function	Default
K1	Temp probe	NC
P10 P12	RS485 COMM	NC
P11	RS485 Terminator	OFF
P13	Reg Bypass	OFF
P15	M1 Disable	OFF
P16	M2 Disable	OFF
J1/J2	Encoder Inputs	to Motors
K1	Temp probe	NC
P13	Reg Bypass	OFF
P15	M1 Disable	OFF
P16	M2 Disable	OFF

P14 Card Address



P14 sets the card address of the card when used in C3Bus systems using RS485. Each EZPlug Servo cards must have a unique address in the C3BUS setup. Cards are shipped not setup for C3Bus connection, See C3Bus (USB-RS485 4 Port Hub) Manual for more detail

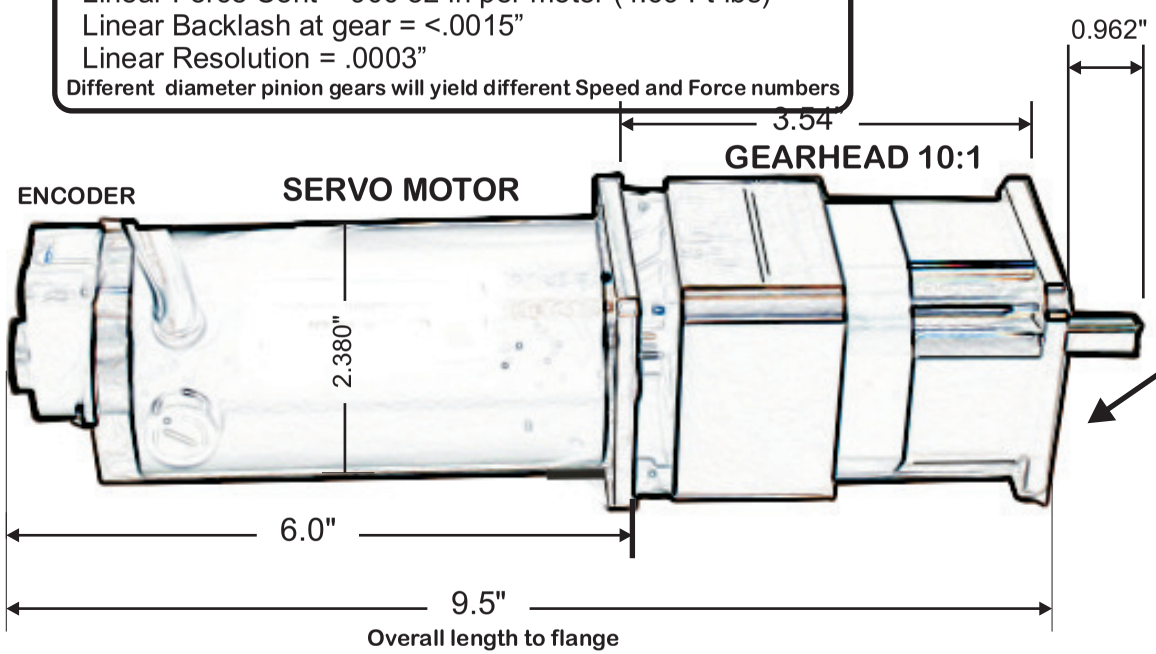
P15 & P16 are used to disable one driver side or the other. This is to use when only ONE driver on a card is being used (like on a 3 axis system or a 5 axis system). If the card does not have a motor drive in the M1 or M2 location the Disable jumper for that side must be ON (jumper in place).

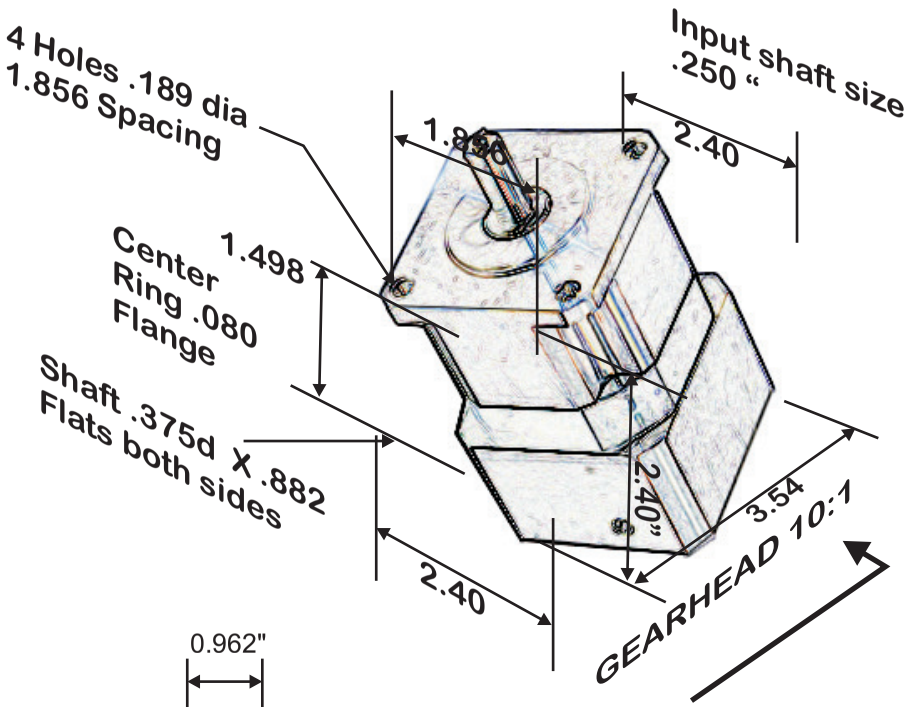
BladeRunner 23 Frame Servo
Motor & gearhead Dimensions

Servo Motor:
23 Frame flange mount 1/4" Shaft
Max RPM @ 60VDC = 4700
Continuous Torque = 50 oz-in
Continuous Current = 3.5A @ 50 oz-in
Peak Torque = 328 oz-in @ 20A

Gearhead:
Input (female) = .250 Output (Shaft) = .375 dia
Ratio : 10:1 reduction
RPM Max = 470 RPM
Torque Continuous = 450 oz-in
Torque Peak = 3200 oz-in
Radial backlash 10 Arc-minutes max

Direct drive to 1" DP Pinion Gear:
Linear Speed = 1200 IPM max
Linear Force Cont = 900 oz-in per motor (4.69 Ft-lbs)
Linear Backlash at gear = <.0015"
Linear Resolution = .0003"
Different diameter pinion gears will yield different Speed and Force numbers





Planetary Gearhead
Front View

PHYSICAL

Combined Overall length 10.5 "
Diameter (max) 2.5 inches
Weight (combined 5.4 lbs)

Encoder Line Count = 250
Pulses per Rev = 1000
Resolution = .0001 per step

Approx Steps per Inch with 1"
DP Pinion gear to rack = 3183

ADDENDUM SERVO MOTOR SETUP AND TUNING

The BladeRunner Servo systems ship with 4 (or 5) servo motors and on the XY motors (3) there are 10:1 gearheads. The following pages should be used to do the calculations for the calibration and to determine the best velocity and acceleration. In addition to the normal motor tuning in MACH the Gecko G320X drives have a PID set of pots that can be used to do added response tuning of each motor. **The PID settings are done during final testing prior to shipping and seldom need to be adjusted.** We have included excerpts of the tuning process from Gecko but unless you are experiencing motion induced fault issues, than **doing adjustments just to see what it does will not "fix" anything**. While different loads can alter the response of the servo it will not effect the accuracy. The servos are never at rest if they are powered up. As a result they WILL make noise. If you attempt to tune them for no noise or minimum noise you will have a "sloppy" system. Even a poorly tuned system will not allow a lot of error in position to

SERVO TUNING 101...Tuning by ear

If you don't have a dual channel oscilloscope and the experience to use it, the easiest way to tune a Gecko drive is by sound. The following covers that method and will yield good results.

DO THIS ONLY IF YOU ARE CONFIDENT THAT THE MOTORS ARE EXHIBITING SYMPTOMS OF IMPROPER TUNING! Most problems are mechanical (backlash, loose gears/pulleys or settings in MACH) and cannot be helped with driver tuning)

This should be done ONLY if you experience any of the following:

1. Any motor that pulses slowly or is completely quiet qhen powered and not moving.
2. An axis that faults often when you are accelerating the motion

NOTE it is normal for a servo to fault and the ESPII to throw a fault when you do an emergency STOP in MACH. The motor cannot stop instantly without causing a fault

Faults from other issues like overloads and noise cannot be fixed with motor tuning!

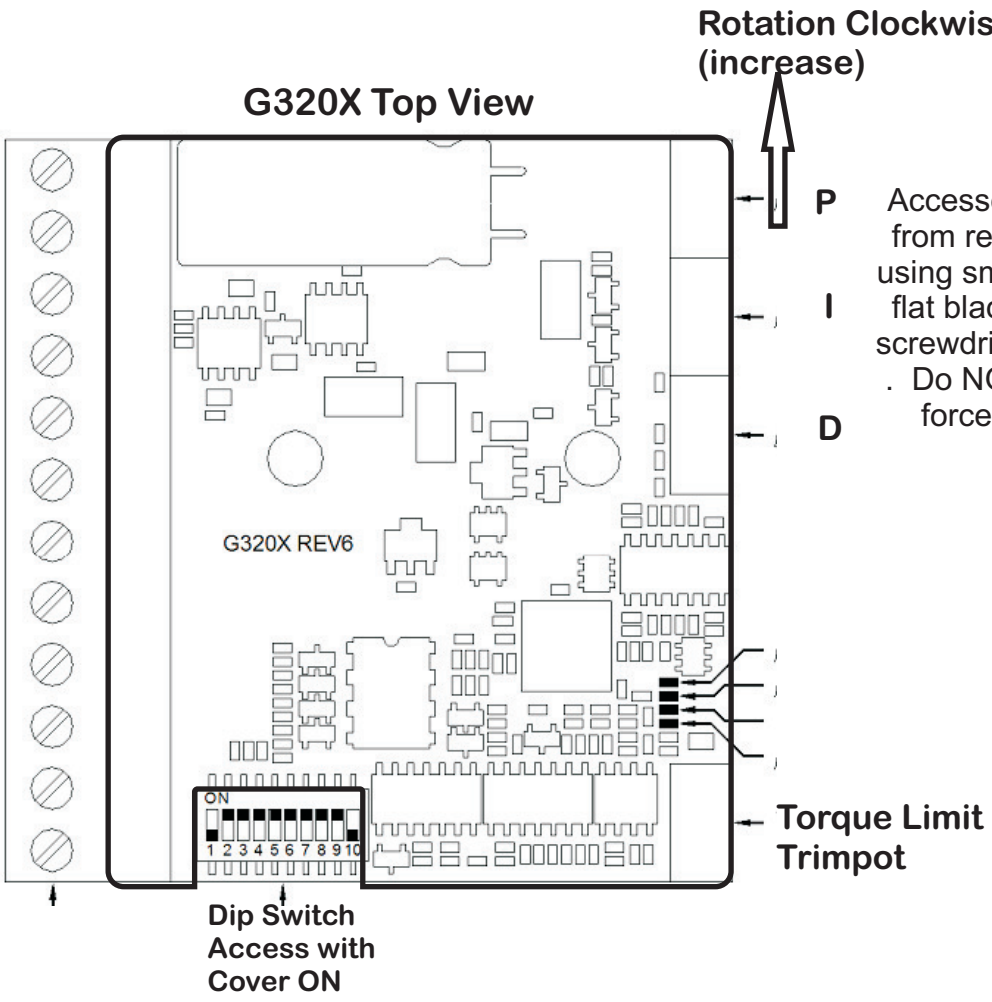
The motors need to be mounted and under load to do tuning by ear.

1. Power up the motors. It may be easier to disconnect all but one motor and encoder apir at a time so you can hear just that motor. if you accidently try to jog a motor that is not connected the Gecko drive WILL fault.
2. Make sure the motor under test "locks". If it starts to move than make sure the encoder is plugged in for that motor. If the motor losses encoder pulses (either channel) it will start to run away (spin at full speed huntting for a line on the encoder)
3. The motor should "hum". The frequency is typically below 220 hz (octive 3 A on the music scale). The important thing is that the motor does not sit and pulse indicating it is way over dampened. The higher the frequency of the "hun" the tighter the tuning. There are two main controls: The P and the D pots. The P is the gain and as you increase it the hum frequency will go up.

4. Start with the D pot turned all of the way counterclockwise (minumum) and slowly advance the P pot until you either hit a point it gets unstable and the motor starts to twitch (oscillate) or you have it turned all of the way up. Make a note of the pot position and back it off until the oscillation stops and then advance it to a position below that point. Now increase the D (dampening) and listen to the frequency...it will drop. Stop the D at about 1/4 turn and then advance the P past where it became unstable before. If it starts to become unstable note the position and back it back down then advance the D some

5. Start with the D and I pot turned all of the way counterclockwise (minumum) and slowly advance the P pot until you either hit a point it gets unstable and the motor starts to twitch (oscillate) or you have it turned all of the way up. Make a note of the pot position and back it off until the oscillation stops and then advance it to a position below that point. Now increase the D (dampening) and listen to the frequency...it will drop. Stop the D at about 1/4 turn and then advance the P past where it became unstable before. If it starts to become unstable note the position and back it back down then advance the D some more and turn the P back up. The objective is to have high gain but with enough dampening to keep the loop stable under all conditions. Once you have established the highest gain (P) that you can support at a given D then back it off a little and leave the D where it is. Do not set the motor so that it is silent or pulses. After you have the P and D set raise the I and that increases the dampening curve
Once you have the motor tuned in a static (non-moving setup) connect to load, than set the tuning in MACH up to a high number (75 to 100) for acceleration and jog the motors at full speed and change direction several times. If the motor driver faults that lower the P slightly raise the dampening slightly by increasing the I setting. Once you have one motor tuned correctly listen to the frequency of the sound. Use that as a guide to tune the rest of the motors.

6. **Setting the Torque Limit Trimpot**. For 23 sized servo motors used on the BladeRunner Servo system set the Torque Limit Trimpot to ½ range (centered between full CW and CCW rotation. This limits current to 10A max. Leave Dip Switch 10 set to OFF to prevent a 20A 1 sec peak cycle.



SW1 Not used

SW2 Current or voltage mode select
ON – Current mode (default)
OFF – Voltage mode

SW3, SW4, SW5 Current mode servo gain
SW3 "ON", SW4 "ON", SW5 "ON" = Low gain (default)
SW3 "ON", SW4 "OFF", SW5 "ON" = Medium-low gain
SW3 "ON", SW4 "ON", SW5 "OFF" = Medium-high gain
SW3 "OFF", SW4 "ON", SW5 "ON" = High gain

SW6, SW7 Sets the G320X pulse multiplier
SW6 "ON" and SW7 "ON" = Step pulse times 1 (default)
SW6 "ON" and SW7 "OFF" = Step pulse times 2
SW6 "OFF" and SW7 "ON" = Step pulse times 5
SW6 "OFF" and SW7 "OFF" = Step pulse times 10

SW8, SW9 Sets the G320X following error limit
SW8 "ON" and SW9 "ON" = +/- 256 count following error limit (default)
SW8 "OFF" and SW9 "ON" = +/- 512 count following error limit
SW8 "ON" and SW9 "OFF" = +/- 1024 count following error limit
SW8 "OFF" and SW9 "OFF" = +/- 2048 count following error limit

SW10 Sets the G320X current limit trimpot behavior

EXAMPLES
50 oz-in Servo motor @ 60 VDC with 10:1 gearhead and 1" dia pinion gear & direct drive:

Max possible IPM = 4700rpm/10 X 3.142 = 1476 IPM.

* linear force = 100% servo motor continious torque X gear reduction / pinion Radius = (50 Oz-in X 10) / .5 = 1000 linear oz of force

Same design but with 3:1 belt reduction from motor to pinion shaft:

* in the above calculations the motor RPM and torque numbers of 100% were used since servo motor torque does not drop off with RPM. These are maximum numbers and NOT recommended for normal cutting and rapids. High values of velocity and acceleration put maximum stress on components for little benefit.

Calculating the beginning Steps per Unit on an SERVO AXIS

Use the following formula to get a ballpark steps per unit number in MACH

Psr = Pinion Speed increase ratio = Pitch Dia [in inches] X PI [3.1416]

Steps Per Rotation (SPR) of motor = encoder line count X 4; [250 line count = 1000]

Target Steps per Unit = (SPR X gearhead Reduction ratio/PSR)
1000 X 10 / 3.1416 = 3183.091 steps per inch

Once you have the calculated the number of steps it takes to move the axis one inch then put that number into the STEPS per UNIT of the motor.

NOTE: IF you have the Step Multiplier on the Gecko set to 2X than you must divide the Steps per Unit by 2

Based on the speed numbers you have calculated from the previous pages set you velocity to a value of 50 to 80% of that number.

NOTE: MACH can only send the number of pulses per second as set in the Kernel Speed in Ports&Pins. The number of pulses per second you need is the target RPM (max) X the SPR/60. For a target RPM of 4000 and 250 line encoder you need 40000000/60 = 66,666.0 steps per second (66 thousand) if your Kernel speed is set to 45,000 (default) than you cannot achieve 4000 RPM. The step multiplier in the G320X multiples the steps from the PC so a 2X setting makes the steps per second required from the PC to be 33,333. The trade off is that it drops the resolution by ½ as well.

Set your Beginning Acceleration to a low number like 10

Calculating the max IPM you can travel (limited by max motor RPM)
4500 RPM = 75 RPS
Kernel Speed / SPR = RPS
45000/1000 = 45 RPS
Final Speed is limited by the smaller of the above two numbers
Pinion RPM = (RPS/ gearratio) X 60
IPM = Pinion RPM X Psr

For 45,000 and 250 line encoder:
(45000/1000) = 45 RPS
Pinion RPM = (RPS/10) X 60 = 4.5 X 60 = 270 RPM
IPM = 270 X 3.1416 = 848,23

RECOMMENDED SETTINGS FOR BladeRunner Dragon Cut with 23 Frame servo motors and 10:1 Gearhead reductions

Recommened pinion DIAMETER : 1” (25mm)
Recommended belt reduction to pinion : NONE
Maximum belt reduction to pinion 2:1
Velocity XY and slave : 500 IPM (12700 mm/min)
Acceleration XY and Slave 35 to 50 IPS/sec **
Steps per unit XYA 3183.091 (1” pinion)
Velocity Z (5 turn Leadscrew) 300 IPM (7620 mm/min)
Acceleration Z : 20 IPS/Sec
Steps per unit Z = 1000 X leadscrew TPI
THC Rate (Mach setting) 20 **
Recommended Span Voltage (Cut Proffile) 4 to 8 **
Recommended plunge rate (SheetCAM) 50 - 100 IPM
Recommend DTHC Delay (SheetCAM or Cut Profile) 1.5 to 3 sec

** These settings may need to be adjusted depending on your mechanics to get smooth cuts. Always adjust one parameter at a time.